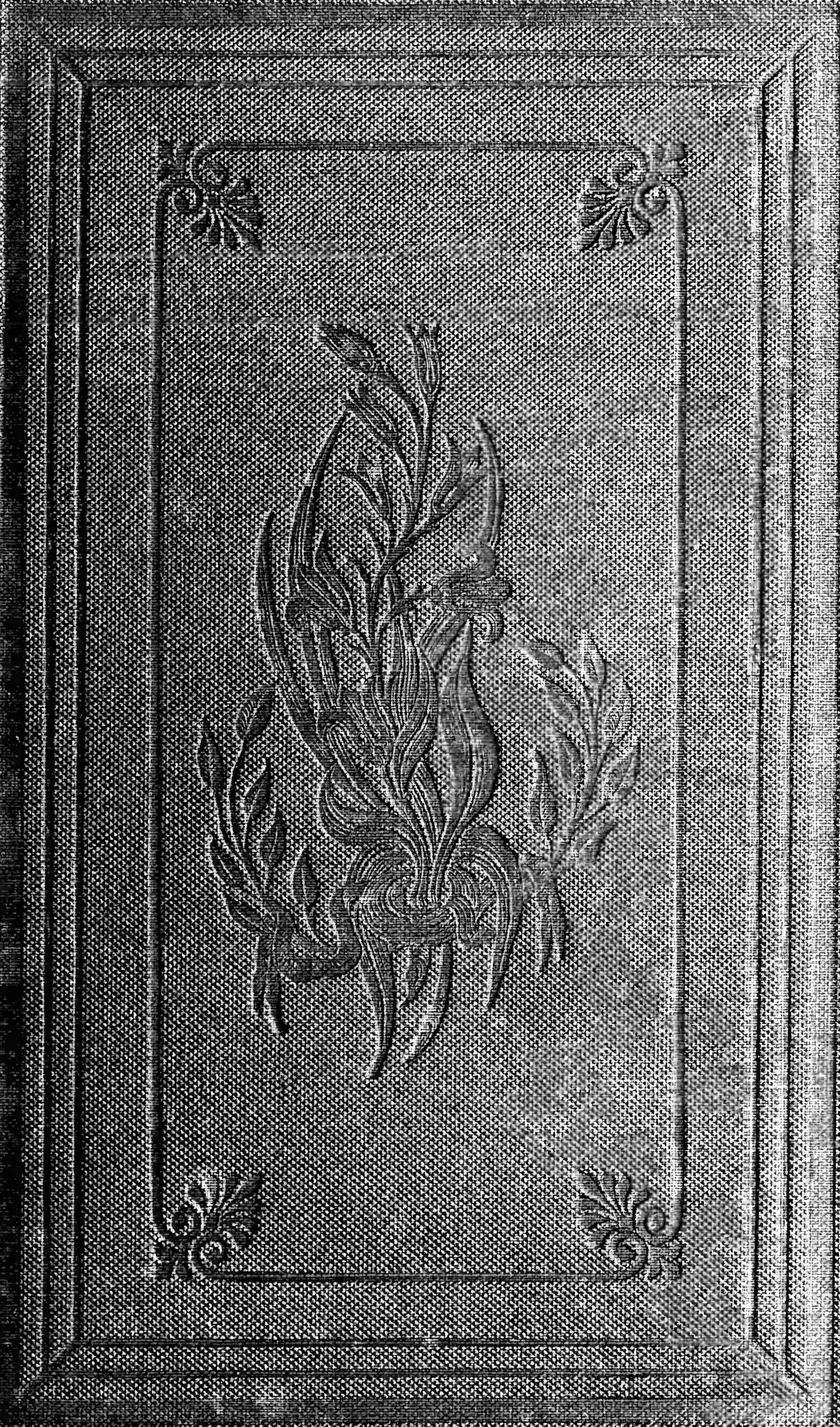


THE

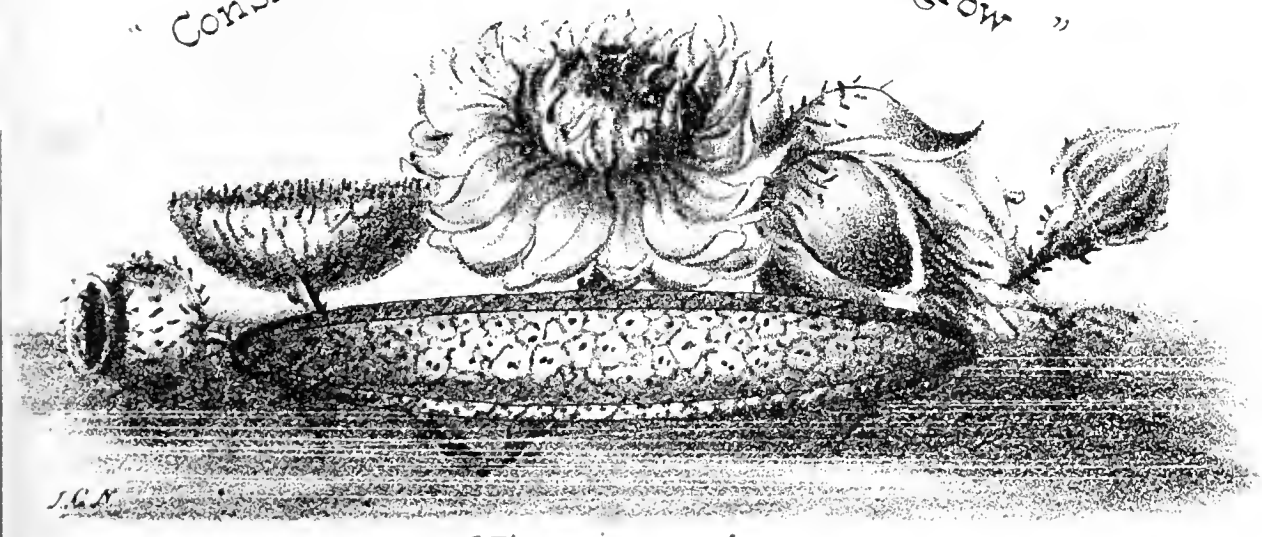
Economy of Vegetation

OR

PHŒNOMENA

OF

Plants.



Victoria Regina.

London.

ECONOMY

OF

VEGETATION.

'Non canimus, surdis respondent omnia Sylvæ.'

BY A FELLOW OF THE LINNEAN SOCIETY.

LONDON:

RELFE AND FLETCHER, CORNHILL.

MDCCCXXXVIII.

SOUTHAMPTON :
PRINTED BY FLETCHER AND SON,
HIGH STREET.

TO

SIR WILLIAM JACKSON HOOKER,

L.L.D. F.R.S. L. & E.

Regius Professor of Botany in the University of Glasgow.

Dear Sir William,

I beg you will have the goodness to accept the inscription of this little volume. It is indeed a very humble tribute; but as it is a testimonial of respectful esteem, and record of my obligations for your repeated courtesy and kindness, I am quite sure that it will be as frankly received as it is cordially tendered.

I ever am,
My dear Sir,
Your obliged, faithful, and
Obedient servant,
THE AUTHOR.

Hull, Sept. 15, 1838.

PREFACE.

THIS little work is ushered into public notice by no peculiar pretensions. I am simply desirous of exciting a taste for, and attachment to, this pleasing and fascinating study, because its *tendency* is happy, and its *usefulness* is admitted on every hand.

While I have been reserved in the matter of technical nomenclature, and the formulæ of scientific detail, I have endeavoured to present a *popular* view of the subject, in conformity with the philosophy of a NEWTON, who, in all his disquisitions, never failed to acknowledge that GREAT BEING from whence the phenomena proceeded, and on whose providence they hinged. These are principles, which, as his humble fol-

lower, I am proud to vindicate, and I hope I shall never compromise or betray. This recognition, though a very reasonable one, may be deemed OBSOLETE by many, and has been too often *forgotten;* but the longer I live, I only see its *importance* the more.

In virtue of this conviction, I have not shunned to refer, frequently, to such peculiar phenomena in vegetation as seem to manifest the most palpable evidence of the beneficent arrangement, and DESIGN of a PROSPECTIVE PROVIDENCE; some of which may have been altogether overlooked, or at any rate, not presented in the same aspect.

"Go! praised enough, and proud, if thine the power
To please one feeling heart, for one calm, thoughtful hour."

ECONOMY OF VEGETATION.

CHAPTER I.

Introduction—Animal and Vegetable Being compared and distinguished—Definition of a Plant—Anatomical Structure of Vegetation.

THERE are few topics that excel in interest, or may compete with the varied charms of the economy of vegetation. There is indeed an exhilirating and refreshing enjoyment connected with the pursuit, which renders the task a pleasure, and the labour a delight. It is the domain of beauty, and the temple of the graces. Health and enjoyment reward the toil of the student in this field of research, and in the peaceful laurels which are his reward, he ministers essentially to the happiness of others, by enhancing the tone of enjoyment and refining the pleasures of taste. Vegetation places a new grace on the brow of the picturesque, and what is beautiful and sublime in the enamelled

landscape of temperate climes, or in tropical scenery, have received their gifts from the iridescent hues of her mantle, or the magic wonders of her plastic power.

There is another consideration that tends to exalt the interest and importance of the science, in the estimation of the wise and good; namely, that the study supplies the most ample proofs, at once clear and conclusive, of the wisdom and goodness of the Supreme Creator; and the demonstration is so lucid and incontrovertible, that no sophistry whatever can elude its force, or escape the conclusion.

The domain of vegetation supplies an inexhaustible variety of the most beautiful and graceful forms, while the singular adaptation of many cannot fail to surprise and to charm. The living picture, indeed, revealed in the economy of plants, forms a panorama of assemblages unrivalled and alone.

A taste for these delightful pursuits seems to be identified with our being, and if circumstances and opportunities concur to favor the predilection, 'grows with our growth, and strengthens with our strength.' The 'daisy,' or the 'buttercup,' is the loved delight of playful infancy; while the early associations connected with violets and cowslips,

the primrose, daffodil, or forget-me-not, will often touch the sympathetic chord of remembrance; and to crown the argument, the divine Author of our religion, pointing to the lovely flowers that wave over and adorn the fields of Palestine, bid us

'Consider the lilies of the field, how they grow,'

an ample warrant for the excellence of the pursuit.

"When the little hills rejoice on every side," the contemplative mind will also rejoice in the emphatic silence of their joy, and that willing mind be led captive by the graces and the beauties that are scattered in rich profusion, and invested with gay attire amid the decorations of the garden of creation. Wondrous structures, fantastic textures, and gigantic forms, replenish the landscape; and in contemplating the perfection and excellence of Infinite Wisdom, we shall soon discover that there is 'no work like to his work.' There is more poetry in the truth unveiled in the phenomena of plants than ever started into being amid the fabled wonders of imagination, and her romantic creations.

Plants are our attendant retinue on heath, or hill, in copse, or meadow, and they fill the mind with repose and pleasure. A Bacon, and an

Evelyn—in fact, the great, the wise, and the good, have, in every age, found their chief recreation, and a source of abundant enjoyment in these studies and pursuits. Lord Bacon pronounced a garden to be "the purest of human enjoyments," and he was right in the estimate. "The breath of flowers," says he, elsewhere, "is far sweeter in the air where it comes and goes, than in the hand."

Amid the groves of Academus did the philosophers of Greece, in classic times, cultivate their abstractions, and beneath the shade of the sacred banyan, do we now find the devotee on the plains of Hindustan, absorbed in the contemplations of Brahma, or the avaters of Vishnu. The patriarch planted an oak on the Plains of Mamre, and rested at noon beneath its shade. The oaks of Dodona, and the symbolic tree of Parnassus, still live in our classic recollections.

Cast over the most miserable hovel a tapestry of ivy, mingled with jessamine and roses, or the clematis, honeysuckle, and passion-flower, and the magic wreathe transforms the poorest cottage into a scene that a poet might celebrate in song, or a painter transfer to his canvass. There is not only a moral in flowers, but a poetry in plants. In eastern climes the hyacinth and narcissus combined, bids the stranger welcome; and a bouquet of

flowers, appropriately selected, forms an oriental letter expressive of the sentiment of love, or a compliment dedicated to beauty. If the bulbul be the object of song, the much-loved rose—'sultana of the nightingale'—is the associate. In fond attachment, the Nubian calls his country 'the land of roses;' and with the Indian of the east, the world is a plant, and India its flower. The sweet-scented sambac, and the ornithogalum corymbosum, mingle in the toilet of Persian belles. The cape jessamine, amaranthus, and others, are worn by the natives of Polynesia. The Arab peasants crown themselves with chaplets of flowers, and I have seen those of Ferrara come to market wearing garlands formed of the flowers of the tuberose.

The flower-stalk of the lofty dove-flower is carried in the religious processions of South America; and the vermillion blossoms of the *amhertia nobilis* are employed to adorn the temples of the Burmese. On the banks of the Guadalquiver, in the Old World, and the Susquehanna, in the New, garlands and wreathes of flowers are worn on holidays, and in scenes of festive mirth. The Turks plant the cypress as the symbol of immortality in their Necropolis, or 'City of the Dead.'

Plants and flowers have been the symbols of countries and of kingdoms, and have figured in

the armorials of empires and of cities. The silphium appears on the coins of Cyrene, and the flower of the lotus on those of Rhodes. The date palm is symbolic of Judea, and is found on medals commemorating the conquest of Palestine, as in those of Vespasian; and the same recognition appears on some Babylonian signets. In like manner, the olive may be seen on Athenian coins, and on some of those of Augustus.

In our own times we recognize the *rose* as the symbol of England, and the shamrock* as that of Ireland; Scotland's badge is the thistle,† and that of Wales is the *leek*. The '*fleur de lis*,' or iris, is the adopted symbol of France, and the lily that of Portugal. The proud and chivalrous name of Plantagenet, of Lancaster's royal line, was derived from a sprig of the *broom*, planta genesti, worn as a characteristic badge.

The olive branch, borne in silent triumph to the ark, by Noah's bird, has ever since continued to be the symbol of peace and amity. The conqueror in Rome's classic days wore a diadem of laurel, and his pioneer carried before the triumphal car a branch of the palm. Oak leaves formed the civic

* *Oxalis acetocella*, according to Bichino.

† Agreeable to the authority of Sir William Hooker, the common *cotton thistle*.

crown, and the prize awarded to the victor in the olympic games, was a chaplet composed of parsley leaves.

Architecture has borrowed the plumes of her fairest graces and loveliest ornaments from the elegancies of vegetation. The beauties of the Parthenon were in a great measure plundered from this source. The *acanthus mollis* supplied the rich foliage which graces the capital of the Corinthian column, while the flower of the lotus, or the 'rose of the Nile,' crowned the gigantic pillars of Thebes, Elephanta, and Elora. The *lotus*, indeed, forms a conspicuous and prominent figure among the hieroglyphics of Egypt; its buds, and its blossoms, decorate the thrones of Osiris and Isis, and bend over the mystic altar.

From vegetation poetry has caught her promethean fire, and whether sacred or profane, this is the pure source of her holiest and loveliest imagery. There is in

"The climes of the East, and the Land of the Sun,"

scarcely a plant to be found without its symbolic meaning, or a flower without its appropriate language. The palm tree, the cedar—"the glory of Lebanon"—the myrtle tree, and the 'shittah-

tree;'* the fig tree, and the pomegranate; the almond and the olive; the 'rose of Sharon,' and the 'lily of the valley;' the "twice blooming rose of Pestum,"† and Anacreon's lily, are sufficiently characteristic: nor must we forget that the 'lily-work' of the temple, with its 'knops, and its flowers,' was copied from the 'pattern shewed in the mount.'

The improvement of taste in the arts of design, is not one of the least important features connected with the cultivation of this section of science, and for want of it has arisen all the monstrous incongruity observable in figured patterns, as painted furniture, paper hangings, and silk and muslin dresses. These offend the chastened and classic eye of taste, and the incongruity will leave its impress, though the individual may be ignorant of botanical science. It is no uncommon thing to see the flowers of one plant combined with the leaves of another, and perhaps associated with the stem of a third! or they may be the sorry creations of a morbid imagination, and a rueful taste, that set the laws of congruity at defiance,—

> "Things that might be worshipped on the bended knee,
> And yet the second dread command be free;"

* *Acacia nilotica.* † 'Rosaria biflora Pesti.'

for their similitudes and counterparts are nowhere to be found. Crabb, indeed, in his evidence before a committee of the House of Commons, in relation to the question, expressly assigns this as one of the chief causes of the superiority of our continental neighbours. The French copy diligently from nature, hence the chaste elegance of their patterns, and the immeasurable superiority of their artificial flowers. Would the rosebud, or blossom, look so fair and lovely on the stem of the lily, as on its native twig; or would the amaryllis appear so graceful if perched on the rose, as it does in nature? There is indeed a harmony and congruity in vegetation we would do well to study and to copy; it would supply the mind with images elegant and graceful, and correct the taste; the spiræa japonica is pretty, and the drooping racemes of the humea elegans, contain the elements that form the lines of beauty, and contour of the graces. Much more might be said, if more were needful, on this important point.

Nor is the subject void of interest of another kind. The ingenious mind has received important hints, and learned lessons of usefulness from contemplating the structure and port of vegetation, while incidents connected with some of her phenomena have not been lost. The fall of an apple

imparted to the gigantic mind of NEWTON the sublime idea of universal gravitation! The trunk of the oak supplied Smeaton with a pattern for that splendid and imperishable monument of his genius, the Eddystone lighthouse. Bruce found the *triangular* stem of the 'paper reed'* buffeting the rapid waters of the Jordan, and still maintaining an erect position; this peculiar form, adapted so admirably to the circumstances under which it is found, might afford an important hint for the defence of the buttresses of bridges, and counterfortes to piers and breakwaters; indeed, I remember to have seen this very principle successfully adopted by the French engineers, in reference to the bridges at Alexandria in Northern Italy. In further corroboration of the practical value of the position assumed, I may refer to Mr. Dredge's new and superior suspension bridge; its strength has been tested, and its value decided by competent authority. While walking with Mr. Dredge in his garden, I can remember he plucked two leaves, one on either hand, and conjoining their tips, 'these,' continued he, 'contain all the principles of my suspension bridge.' The leaves to which I refer, were those of the *laurus nobilis*,

* Papyrus antiquorum.

and *aucuba japonica;* and indeed the mid ribs, and lateral, or diagonal bracings, exhibit a complete picture of Dredge's suspension bridge. The suspension bridge which it is proposed to erect over the Avon, from St. Vincent rocks at Clifton, agreeable to estimate, will cost somewhere about £60,000, if indeed that sum be not materially exceeded; while Mr. Dredge told me the estimate, on his principles, would not be more than ONE-TENTH the amount! Considered, therefore, in this new relation, the study of the economy of vegetation may be of incalculable value.

There is yet another aspect of the study of no mean estimate in the advantages conferred by vegetation of a peculiar kind. The mangrove contending with the ocean for fresh conquests of land, invades the dominions of the sea, and thus consigns new territories to man, or contracts the dimensions of the lagoon, and finally usurps the district, and becomes the lord and tenant of the soil. The drifting sands of the sea shore are arrested in their incursions and invasion of the fertile soil, by some such plants as the 'sea reed,' and 'sea seg.' These indeed are the centinels of Providence, and seem to say to the sand flood, as well as to the waves of the sea, 'hither, and no farther,' and 'here shall your waves be stayed.'

For want of the 'preventive service' of vegetation on our sea coast, the ocean waves riot on the land, and where these trusty and useful 'weeds' have been recklessly obliterated, as on a part of the coast of Scotland, valuable property has been destroyed, and a once fertile soil become the prey of sterile sands. St. Ives, Cornwall, occurs to me as illustrating the protection afforded by the 'sea bent,' and its associates; and Spurn-point, protected by these plants, secures the tract of country within its basin from becoming a victim to the waves of the Atlantic. The only security which Holland possesses is derived from 'weeds' like these. The teredo, or the pholas, perforates and destroys the piles along the coast; but these plants maintain their ground, and repel the assaults of the waves. We turn from the rude mockery of Xerxes and his impious chains, and Canute and his courtiers on the sea shore, to these commissioned servants of Providence, and feel refreshed by the striking contrast. In Holland commissioners are appointed by government for the protection of these plants. Our forefathers wisely guarded them from spoliation, by penal enactments, and these acts of parliament are still in force.

We have not said how much the arts and manufactures are indebted to vegetation for their sup-

plies, for volumes might easily be filled with the detail. The simple question of cotton might well suffice for more than one; then there is the *dipsacus fulonum*, so valuable for the clothier. Without the supplies received from the luxuriant bounties of vegetation, the streams of the arts and manufactures would be dried up. Medicine finds her balms and anodynes, and her 'juleps, and catholicons,' in plants; and by her exuberant bounty the tribes of tropical climes are well supplied. We, too, participate abundantly in these gifts of Providence, and the sacrifice of 'balm, frankincense, and myrrh,' may well be offered up at the shrine of gratitude.

But under these preliminaries recommendatory of our science, it may now be reasonably asked, was all this costly furniture of the vegetable creation, and such an expensive array of beauty, and of worth, intended merely for the use of MAN, and to be the essence of his exclusive interest and delight? Doubtless, chiefly for him who best can estimate the rare excellencies of their combined worth and value; but it is equally true that myriads of plants unfold in wastes, and in impenetrable forests, where man has never been, and man may never see; or should the traveller, in his weariness, catch a transient glimpse of these floral

beauties, the enjoyment is evanescent, and the impress soon fades away. But though the foot of man may never tread the precincts of the wilderness, or the waste, these are not "forsaken places;" and who has descended to the 'bottom of the mountains,' to explore the coral caverns of the ocean, where the 'sea-flowers' grow, and marine vegetation luxuriates? Myriads of living beings tenant these regions, and to their *enjoyment* for aught that we can tell, the multifarious tribes of plants may essentially contribute, irrespective of ministering to their necessities. The flowers of the desert and the depth cannot belong to the province of man, or be considered his property. Each plant has its attendant retinue of insects that wait upon it, and there is a favouritism in some birds for particular flowers. The golden wren delights to revel and to warble within the pendant bell of the crown imperial; the humming bird singles out the fuschia, or selects a kindred beauty; and even the nightingale, on her return from migration to this country, is said to exhibit a predilection for the spot where the cowslip grows; certainly eastern poets fancy that the *rose* is her delight. Even the *cat* has her selected plant, and the specific name is appropriately expressive of the choice—*napeta cataria*.

Nocturnal flowers can only benefit night-faring animals—moths and fire flies, bats, owls, and their nocturnal associates, and we should remember the insect, and other forms of flowers, and the fact that insects and birds are lured by particular plants. We may well extend an enjoyment to them, kindred to that of our own, and commensurate with their capacities of enjoyment—and why should they not enjoy

> "These beauties of the wilderness,
> That make so gay the solitary place,
> Where no eye sees them?"

The curious question connected with the economy of vegetation implies more than is included under the term botany, as usually accepted and understood. The physiology of vegetation embraces the entire history and phenomena of the plant, and comprehends the annals of life, from its commencement to its close. The question, moreover, considers its anatomical structure, or the mystic apparatus of pipes and organs, cells, and vascular tissues, connected with its machinery. The functions performed by the principle of life in the organized being, such as those of absorption, assimilation, and secretion, with the reproduction and perpetuity of the individual in the transmission

of the gift of life from age to age, form the materials of another section of this curious and interesting enquiry.

I next proceed to consider the characteristic distinctions between animal and vegetable being—a more difficult definition than a superficial glance would pronounce it to be. It has been assumed that animal being subsists on organic matter, or materials obtained from an organic source, whether animal or vegetable; and on the other hand, that vegetable being as exclusively lives on inorganic, or mineral matter; but Mr. Kirby has described an insect that lives on mineral substances, and the Otomacs, the natives of New Caledonia, and even the Laplanders, at particular periods, and in seasons of scarcity, use earthy materials as articles of food.

On reference to the chemist we find that his subtile art cannot decide the matter. Azote, or nitrogene, it must be allowed, forms an essential ultimate element in animal substance, and is an invariable constituent; but it is equally true that nitrogene is found in mustard and other pungent plants. In some cryptogamous plants it is not uncommon; and *ammonia*, which contains nitrogene, as one of its chemical elements, is developed in others, as in the *chenopodium vulgaris;* and the diffusion of odours, it is not improbable, may be

connected with the presence of this gaseous body.

Apart from the considerations in question, as far as my own observations and experiments have extended, I am decidedly of opinion that some plants are more indebted to animal matter, in a state of decomposition, for their support, than to any other source of supply; and I am strengthened in this conviction by the experiments of Knight and Salisbury on the *Dionœa muscipula*, or the Fly trap; for they found that when the plant was cut off from the usual medium of supply by being covered with a bell glass, it sickened and died, while another plant under similar circumstances, when supplied with fibres of animal muscle, continued healthy. Allied to this plant in the phenomena presented, is the sun-dew, especially the *drosera rotundifolia;* at least this is the species that has chiefly engaged my attention, and on which I have made my observations; though other species, as *drosera anglicana* and *drosera angustifolia, (or filiformis)*, are connected with the same class of phenomena. The leaves of the 'round leaved sun-dew,' are often covered with insects impaled on their surface. Even the *pinguicula vulgaris*, or common butterwort, may be ranked among the vegetable 'fly catchers.' In the dionœa muscipula, we perceive a curious me-

chanical contrivance, like a spring rat trap* for capturing its victim and securing its prey: but in the sun-dew the capture is effected by more complicated means, namely, that of a viscid exudation combined with a gradual collapse of the hairs which stud the leaf. The 'roridula' of the Cape and some others, are allies of a kindred character: besides, the pouch leaves of the *sarracénias* are true sarcophagi, or living tombs; and ammoniacal gas is readily detected escaping from their mouths, arising from the decomposition of animal matter. In dissecting these leaves, I have discovered multitudes of insects, dead and dying. In the case of a pouched leaf of the Sarracenia flava (plate 11. fig. 15,) I found several dozens of insects, particularly of a minute ant, house flies, and others. These curious leaves are lined with bristles pointing downwards, like the wires of a mouse-trap; the entrance is easy, but escape almost impossible. The spider seems to be the only insect that can make its escape from these vegetable sepulchres.

Animals sometimes wear the livery of plants, and externally resemble them; such as the *actiniæ* which resemble *marigolds, anemones, asters,* and *carnations,* and even are decorated with their

* These traps open on a hinge, and snap their valves with considerable rapidity and force; the margins are notched, and lock into each other.

chromatic tints. The *crinoida*, or lily-shaped animals, as the *pentacrinite*, &c. are also mimics of vegetable forms.

Nor will fixation to specific spots by any means solve the problem. Some animals are rooted to their localities and fixed for ever; the pentacrinite is one of these. On the other hand there are plants, that, gipsey like, are vagabond: they are not however exiles, for they have no exclusive inheritance or country; they are true cosmopolites and denizens of a world. Uncircumscribed by latitude and longitude, they are the exclusives of no clime, but belong to every zone; even the monkshood and the orchis change their place every year. Many algæ float free and unfixed on the ocean wave: of this description is the everlasting bladder thread which has been met with at sea 1500 feet long, and perhaps also the *fucus giganteus*, which was found 360 feet in length, in a bay at Kerguelen's Island. The *fucus natans*, or the 'sargasso' of the gulph stream, has been clearly proved to float independent of any attachment. It wanders on the wave vibrating with the wind, and forms a striking feature in the gulph of Florida, called by the Portugese and Spanish navigators, the 'Mar do sargaço,' or the weedy sea. The *lemna*, or the 'duck meat,' is a swim-

ming plant, and the water star-grass floats until it flowers. The *pontideria crassipes* of the tanks of India, is equally singular in its physiology; it casts off floating bulbs that sprout and swim about. The *conferva ægrophila*, or globe crow silk, is the sport of the winds, and play-ball of the billows; I have a specimen found on the sea, off St. Malo, on the coast of France; and it is discovered floating hither and thither on the lake of Grassmere, in Westmoreland.

The remarkable irritability and spontaneous motion manifested in the case of some plants, enhances the difficulty and perplexes the subject. Examples of this description are to be found in the case of the dionœa muscipula already referred to, and in that class called 'sensitive plants,' as the *mimosa sensitiva*, *pudica*, and *prostrata;* but above all in the phenomena displayed in the *desmodium gyrans*, or 'moving plant,' from the banks of the Ganges. Sometimes the foliage moves up and down like the vibrations of a pendulum; at other times the leaves exhibit a whirling motion, and occasionally the entire plant seems to tremble. The *vaucheria clavata*, in its germinating state, presents phenomena resembling animal motion; but the *oscillatoria thermale*, I am disposed to consign to the zoologist, as several considerations

compel me to conclude that it has no legitimate claim to rank among the vegetable tribes. I find that by the action of nitric acid it is converted into a substance very analogous to *adipocere*, and it possesses a striking resemblance to animal muscle; indeed it was pronounced to be so by one to whom I shewed it, and who was certainly no incompetent authority. The generic name was first applied by Adanson, who found it in connexion with thermal waters in France, hence the specific term; *oscillatoria*, is a name descriptive of the phenomena presented; the individual fibres composing its tissue being observed to possess a vibratory motion. M. di Gimbernat in 1818, had it cut from the live rock, when it resembled raw animal muscle, and clothed a part of the surface of Epomeo, in the Island of Ischia, in the gulph of Naples, constantly humid from the ascent of hot vapours. It is a very curious and apocryphal substance; a single fibre in the course of a night will clothe the surface of a watch glass, containing water, with its web; a plexus displaying warp and woof.

Notwithstanding the difficulties which surround us, there seems to be a line of demarcation between animal and vegetable organisms, sufficiently clear and well defined. The former appear to

possess *internal digestive sacs*, and the latter are void of them: the pouches of the Sarracenias can scarcely be considered to exhibit any adumbrations of a stomach, and they are external. We cannot admit the 'isthmus of a middle state,' and still less the mutual convertibility of animals into plants and the converse. The researches of Ehrenberg seem to have settled this question, for in even the simplest of the infusorial beings, he has detected complicated structures, such as the *atomus* and *monas termo;* and has even proved them to be *polygastric*, or possessed of many digestive sacs.

In defining the structure of a plant, we are too apt to associate certain parts or appendages, as necessary to their constitution, or essential to their being; or, in other words, indispensable to the completion of what we may dogmatically call a perfect plant: but such assumptions and preconceptions have certainly not been formed in the spirit of a rigorous induction. The intelligent mind will soon discover that a plant is 'a very varied thing.' It may still be *perfect* of its kind, though it may want all but one of the members which we, in our wisdom, are pleased to consider essential adjuncts to the structure of a perfect plant. The *tuber cibarium*, or 'truffle,'* is a *root* and nothing

* Its mode of reproduction is sufficiently singular; the germs are diffused through the mass, and in process of time the tuber falls to pieces, and liberates the future plants.

but a root, yet it is a vegetable being, perfect in its form, after its kind. The *dodder*, (cuscuta) though terrestrial in the first instance, soon snaps its attachment, and becomes rootless; it resembles a mass of red web-like threads, sprinkled among the bushes, as the furze—a mere tissue of inflorescent stems, and yet the dodder is a perfect plant, after its kind. The 'nostocs,' are vegetable beings of of a doubtful structure; and the *rhizomorpha*, found in mines, bears all the characters of a mere *root*, diverging and ramifying on the walls, and yet it is perfect, after its kind; many of the floating *algæ*, as well as the rocky *lichens* are mere expansions, yet are perfect plants. The *rafflesia arnoldi*, and *rafflesia patma*, with others, are mere *flower buds*, and *flowers;* nor root, nor stem, nor leaf do they possess. They are blossoms simply, filled up in the centres of their discs as other blossoms are; but these are, nevertheless, perfect after their kind. We are certainly quite at liberty to prescribe whatever rules we please to ourselves, but have no right to impose them on the perfection of infinite wisdom.

I now proceed to consider the three principal parts of a plant, commencing with the circumference, and proceeding to the centre of the trunk. These several parts are comprehended under the general terms, *bark*, *wood*, and *pith*.

The BARK includes the external cuticle, or epidermis. This appears in the *birch* as a delicate white film; in advanced growth it is of silvery whiteness, and imparts a peculiar feature to the landscape in high latitudes. The epidermis of the rattan cane and the reed, that of the bamboo and of the grass of the field, is composed of *silicious* matter, and this shield or tunic of flint is admirably adapted to defend the last of these, so essential to the existence of the animals that browse on the herbage, from the effects of external injury. The CORK of the *quercus tuber*, or 'cork tree,' is not, strictly speaking, bark, but a *secretion* or excretion of the bark, and overlaps it. A somewhat similar substance may be seen on one of the elms. The parenchyma is a pulpy substance, seated beneath the cuticle, and is the residence of colour.

The LIBER, or inner bark, is the last formed, and displays a fibrous, sometimes a reticular structure. Russia bass mats, and even cordage, are made of the inner bark of the lime tree; which may be easily separated into numerous layers. The liber of the *daphne lagetto*, or 'lace-bark tree,' a native of Jamaica, may, by lateral extension, be formed into a beautiful lace, and is indeed worn, in tropical countries, as an article of ornamental dress; upwards of twelve folds may

be easily separated. That of the 'paper mulberry' is an elegant fabric, and is the 'natoo' of the Tonga Islands, and worn by the natives of Polynesia.

The WOOD is beneath the bark, and composed of concentric cylinders, in *exogenous* growth, one of which is formed annually, the last being in immediate contact with the liber, and is called *alburnum*, or 'sapwood,' while that nearest the centre of the trunk, necessarily the oldest and firmest, is called *duramen*, or 'heartwood.'

The wood forms the skeleton of the plant, imparts solidity to the trunk, and is its mould of beauty; and the various parts are consolidated and preserved by it.

The ligneous skeleton, in exogenous plants, or such as enlarge their diameter, corresponding in some measure with their length, or growth upwards, is increased in volume by the annual deposition of a cylinder of *alburnum*, and a concentric one of *liber*. The wood is replenished with cells and tubes, and is traversed horizontally by what are called *medullary rays*, which have their source towards the centre, where the *medulla*, or pith, reposes, hence the designation. From this point, as from a centre, these radii diverge toward the circumference. They are composed of thin shining

plates, and are called the ‘ silver grain,’ as observable in the *oak*. Sections also of the *beech*, *berberry*, and *laburnum*, afford examples of medullary rays, and especially the *quercus suber*, where they are conspicuously displayed.

Systems of capillary vessels are distributed throughout the entire extent of the skeleton, thus displaying a vascular structure. Some of the vessels referred to, present a spiral form; as may be exemplified by twitching asunder the leaf-stalk of the elder, or dogwood. The spiral coils are particularly beautiful, and of considerable length in the *agapanthus umbellatus*, or ‘ blue African lily;’ and in the *nelumbium cæruleum*, I have withdrawn the spiral fibre nearly eighteen inches long, and when entirely separated, it has ascended in a vertical position to the ceiling of the room.

The MEDULLA, or pith, occupies the centre, as in the *sambucus ebulus*, or elder; it displays a varied structure, and is altogether cellular. In the sugar cane, the structure of the cells is *hexagonal;* sometimes it is found ragged, or torn by the progress of vegetation; occasionally the centre is found void of medulla, as in the *cecropia peltata*, or trumpet tree, of the West Indies. In the elder, during its early stage of growth, it is firm, and full of sap; but when more mature it is dry, light, and

spongy, and the cells have exchanged their liquid contents for aërial matter.

To this part of the plant, Linneus assigned a more important character than it would seem to possess. It bears some analogy to the *cancellæ*, or lattice-work, which occupies the centre of bone.

It was from the medulla of the *papyrus antiquorum*, a triangular-stemmed reed, found among the pools and brooks of Egypt, and which Bruce of Kinnaird found in the rapid stream of the Jordan, that the ancient PAPER was made, once an important feature in the commerce of Alexandria. The 'paper-reed by the brooks,' is an expression that justifies the assumption of its high antiquity. The papyri of Herculaneum and Pompeii, as well as those sometimes found in the mummy coffins of Egypt, were obtained from this source. The process is described by the elder Pliny, and has been successfully repeated by the Chevalier Landolina of Syracuse. I have seen specimens of this modern papyrus in the 'Studio' at Naples, and elsewhere, and compared them with ancient papyrus.

The 'paper-reed' waves its plume on the banks of the Anapus, once the classic soil of Theocritus, and its source celebrated for the fountain of Cyane.

There is, however, another reed found there,

with which it must not be confounded; I refer to the *cyperus niloticus*, or the 'bull-rush' of the Scriptures. It is still used in the construction of boats in some parts of the east, and is employed not only in navigating the inland waters of Abyssinia, but the Tigris and Euphrates.

The reeds are collected stem and stern attached to a keel of accia wood, *mimosa nilotica*, and pitched within and without with bitumen. Such are true 'paper-boats,' and the expression, "vessels of bullrushes," used in prophetic times, is thus elucidated. In a small 'ark,' or boat formed of these reeds, was the infant legislator of the Jews exposed to the current of the Nile.

That commonly called 'rice-paper,' and employed for ornamental purposes, is obtained from the Island of Formosa, but by no means so circumscribed in its geographical range, as it is also found on the peninsula of India. It is cut by a sharp instrument from the stem in a spiral form, and the coil is afterwards unrolled and submitted to pressure. Hats, in the East, are sometimes made from the medullary, or cellular stem of the banana, and the material, from its spongy texture and lightness, is sometimes there called 'cork-wood.'

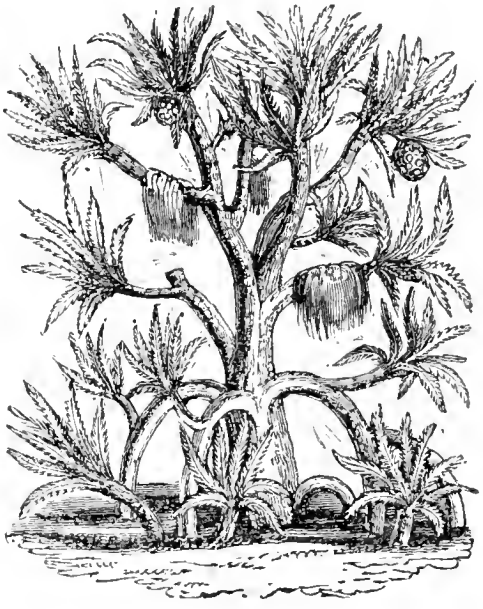
CHAPTER II.

The Root—Stem—Foliage.

The root is that part of vegetation which generally, though not invariably, fixes the plant and penetrates the earth. Its structure is exceedingly various, and its functions by no means exclusive. At first sight it would seem to act a mechanical part, and might be considered as the anchor by which the plant is chained to particular spots on the earth's surface; on closer examination, however, it will be found to be invested with an anatomical structure, which adapts it to other purposes, and we soon discover that it is very variable.

Roots are not an invariable appendage to plants; in the nostocs, for instance, they are entirely absent; other organs in all probability supplying their places. They are diversified in their forms, and the circumstances and conditions under which they are found. Roots generally burrow in the ground, and the plant seems anxious to hide them;

they usually terminate the lower extremity, but sometimes sprout from the tips of the fronds, as



in a peculiar fern. In the *pandanus candelabrum*, as seen in the above figure, tufts of roots spring from the bends of the branches, which are thus chained down and form a series of arches ; a similar phenomenon occurs in the *tree sedum*. The stems of the vine, &c. in a humid atmosphere, sometimes emit roots which, would seem to connect them with hygrometric relations. The banyan and mangrove evolve roots from their branches, which consequently become so many additional mechanical supports, and subserve the purpose of as many distinct channels of supply

from the earth. I have seen a somewhat similar tendency to that of the mangrove, manifested in the case of a Portugal laurel, a few miles from Falmouth: it extended itself in one direction—the branches bent to the earth, and subsequently became erect; forming a complete thicket of distinct, upright stems. Even in the *pandanus odoratissimus*, it should seem that when a branch has become considerably elongated and extended in one direction, a root stem, similar to that of the banyan has been protruded, and finally become a pillar of support. In the mangrove, the roots emerging above ground form extensive arches, and from them springs the trunk, which thus seems to be supported in mid air, or raised on a scaffolding or frame work above the earth. There is a curious palm which presents a somewhat similar appearance, in South America. It seems as if walking on stilts, and I am informed that the space below is occasionally converted by the natives, into an enclosure for poultry. Sometimes the roots of the ash may be seen in bold relief on the surface of the ground; and I remember to have observed in Bolton Priory woods, a mountain ash, springing from the centre of the upper surface of an irregular quadrangular rock of considerable size, and enveloped in a scanty

covering of moss; the roots firmly grasped the rock on every side, and pinioned it to the ground. A more curious phenomenon of this kind occurred in Gallowayshire, and is mentioned by Lord Kames. A sycamore, *acer pseudo-platanus*, planted by the breeze or the bird, grew on the top of a mouldering wall among the ruins of New Abbey; finding only a scanty supply of nutriment, it at length detached a large root downwards, as a kind of *tentaculum*, or feeler, which gradually becoming established in the earth below, the roots above became separated, and the tree thus left the wall entirely. In the *Pandanus odoratissimus*, the stem in immediate communication with the earth is weak compared with the trunk above. The stem, therefore evolves strong shoots, which act the part of 'main stays,' and support the trunk, in the same manner as the mast of a ship at sea is preserved upright and firm by the shrouds and other tackling, when assailed by the tempest. In one specimen I counted upwards of *fifty* of these remarkable attachments, and some of them were nearly an inch in diameter; chiefly emitted from the side *opposite* to that to which it leaned, and appearing at successive heights on the trunk. In one of these aërial shoots, I numbered seven joints, and

it had not yet reached the earth, though all the rest had taken firm hold of it. Aërial roots are discovered on the stems of many plants; in the *clusia flava*, they also take hold of the earth, but in the case of that remarkable tribe of plants called *epiphytes*, their functions would seem to be exclusively connected with the surrounding atmosphere. The stem of the *epidendron ellipticum*, is entirely clothed with roots, and sometimes the adhesion of these aërial fibres is so firm, that they are torn in the fruitless endeavour to detach them from the external surface of the flower-pot or the damp wall.

That roots are a security, and tend to preserve the plant firm in its place, seems sufficiently apparent, from the circumstance that they spread most, and extend farthest, in the direction of the blast. Sometimes roots spread far and wide, and it is probable that this corresponds with the diffusion of the branches above; thus those of the cedar of Lebanon have a wide horizontal range, and hence the beautiful and appropriate expression, "spreads his roots like Lebanon;" at other times, and in peculiar cases, roots may plunge to considerable depths. The roots of Lucerne have been traced to a distance of thirty feet from the plant; and I have found the extremities of the

roots of a small plant of ficus elastica, ramifying on a damp wall to an extent of twenty feet. The main or 'tap root' of the baobab, will plunge to a depth of 110 feet.

The physical force of some roots is truly astonishing; that of the misletoe will thread the bark of the apple tree and dive to its ligneous skeleton. In Pinot's experiments, the vegetating root penetrated the surface of mercury. I have a root that has perforated a mass of flint, and seen another that had passed through a piece of manganese; nor is it incredible that both of these being comparatively SOFT IN SITU, might have yielded to the force of the vegetating root; at any rate, the root-stem of the couch grass will readily pass through the tuber of a potatoe, and I have found two large bulbs of tiger lilies threaded by this plant, like beads on a string. The root of the *swietenia mahogani* penetrates and splits the rock as if cleft by a wedge, and that of a laurel will overturn a wall like the trunk of an elephant. The root of the *cactus opuntia*, or 'Indian fig,' shatters the obdurate lava on the flanks of Etna, and is even planted for the specific purpose of preparing a soil for cultivation, by shattering and pulverizing the rock. Trees and shrubs, therefore, which crown the flanks of mountainous chains, thus rend

the rocks and toss them headlong from their eagle seat into the valley—one cause of the ruin of mountains, as in "Uri's rocky world."

Roots assume a great diversity of appearances; hence the *fibrous*, when it resembles a tuft, or bunch of threads, or strings: this is a very general feature. The *spindle*-shaped root is exemplified in the beet, parsnip, and carrot. Sometimes it is forked, or parted, as in the far-famed *mandrake*, fabled to utter a groan when torn from the earth, and to prove fatal to the luckless wight that heard it. Spells and incantations were deemed necessary as a protection against its powers, and the success of the 'Maid of Orleans' was attributed to the possession of a mandrake root. In the scabiosa succisa, the root seems as if it were rudely broken off. The *bulbous root* finds examples in the *amaryllidæ* and their beautiful congeners. In the onion, the bulb is *tunicated*, or composed of concentric folds; in the white lily imbricated, or scaly; and in the crocus solid, which last in botanical nomenclature is called a *cormus*. The *net-work* which envelopes the cormus of 'the cloth of gold,' and 'cloth of silver,' crocus is very beautiful. The *tuber* is another form of root: it is seen in the *potatoe, yam, arum, &c.* In the *spiræa filipendula*, or 'drop-work,' and in one of the saxifrages, the

tubers are apparently threaded on a string. In the peony, dahlia, and commelina cœlestis, the roots are associated in parcels, or bunches.

Bulbs and tubers are often partially, and sometimes entirely, above ground, as in the *crinum amabile*, the *cyclamen*, and some of the *arums*. Though tubers and bulbs are commonly linked to roots, we find that they also sometimes stud the stem, or repose in the *axillæ* of the leaf, as in the 'tiger lily,' and *begonia*.

Roots are sometimes very singular in their conformation; thus the coral root is like the production whose name it bears. The roots of the arrachaca are of the size and shape of cow's horns. That of the *listera nidus avis* somewhat resembles a humming bird's nest, while the root of the spikenard, *nardus indica*, bears the form of the tail of the ermine. The *rhizoma*, or root-stem of the haresfoot fern has no distant resemblance to a hare's foot and leg; and the root of the *cyperus longifolius* is like a group of tarantula spiders.

The economy of many bulbs is remarkable; they are found, as at the Cape, partially immersed in sand, in some instances, like alembics, in a sand bath; occasionally, a slender hold of the soil is all that is necessary for their sustenance, as in the case of the *amaryllis belladonna*, and especially

the *amaryllis sarniensis;* these, indeed, when the flower bud makes its incipient appearance, may be cast aside on the shelf, or the mantel-piece, yet they still flower profusely, and afterwards as regularly evolve their leaves. This is a very remarkable feature in their physiology; their bulbs evolve *laterally,* and being subject to denudation by the blast of the desert, are oftentimes unrooted and become "like a rolling thing before the whirlwind." This accident does not disturb them—they still flower, though wandering on the desert, and if some sandy hillock arrests their progress for a time, the fibres penetrate the surface, and their exhausted powers are recruited. Denudation in other cases, it is probable, might destroy, and accordingly we find a provision to meet this contingency. The *antholyzas,* and some of the *cape ixias,* form their new bulbs *below* the old, and consequently are *burying themselves* deeper in the sand year by year. Some of the bulbs of the antholyza have accordingly been found more than twelve inches deep, grappling with the subsoil at the Cape.

Strictly speaking, the bulb, or tuber, is *not* a root, but rather the reservoir of nutriment, or moisture. The *hybernaculum,* or winter-house, to which the 'principle of life' retreats at certain

seasons of the year; there the essential parts of the plant, with the *punctum saliens*, reside, and they are shielded from external injury.

Roots sometimes vary their characters, according to circumstances. In a sandy soil the fibrous roots of grasses assume the appearance of a mass of down. The *alopecurus geniculatus*, naturally possessed of a fibrous and creeping root, has been found on the top of an arid ruin, presenting the appearance of an ovate juicy bulb, a fact which also serves to illustrate the economy of some African bulbs, denizens of the desert.

So far from roots being the means of chaining plants to particular spots, they occasionally enable the plant to shift its position, as in the twin lobes of the orchis, and monkshood. The *arum dracunculus* flies off at a tangent from the same cause. Roots have sometimes been called subterranean stems, but they are not clothed with leaves. The change of roots, however, into branches, clothed with leaves, has certainly been effected by turning a willow upside down; a cherry tree, and a gooseberry have also been similarly treated, and with equal success.

Leaves, when planted, will sometimes grow and emit roots; this is the method of culture sometimes adopted by the natives of Polynesia in the

cultivation of the *taro*, one of the arums—*caladium esculentum*. The *bryophyllum calycinum*, *gloxinia bulbosa*, *kalanche crenata*, *&c.* will grow from leaves.

The roots of the silver fir will remain for half a century undecayed, after the tree is cut down, but produce no new shoots; whereas in the case of the willow, after the trunk is removed, the roots will send up in every direction, both shoots and leaves. The phenomenon met with among some of the vallies of the Alps, called *saule-en-herbe*, proceeds from overwhelmed and buried willows, the effects of the debacle, or mountain torrent.

A root may be considered as composed of two parts; the stem, and the lower extremity, or spongiole, supplied with *stomata*, or orifices by which the äerial, or liquid *material*, is absorbed, and it is probable, by virtue of capillary attraction. The terminating spongioles are sufficiently obvious in the water star-grass, and in the hyacinth, when reared in a root glass; and if a needle be passed through, near the tip, it will be found that the root elongates from the lower point. That the root possesses a *selecting* function is clearly proved; if a strawberry, for instance, be planted in the sterile angle of a garden, the repent stem will stretch itself forward in the direction of the good soil, and forsake its former abode.

The root had hitherto been regarded as exclusively *absorbent*, and not excretory; but in some experiments which I made in 1818, it was proved that this was at best problematical; and I thence drew the inference that its functions were *compound*, i. e. both *absorbent* and *excretory;* thus hyacinths grown in distilled water, cut off from extraneous sources of supply, yielded carbonic acid gas, &c., and gum anime is known to distil from the roots *hymenæa courbaril.* Macaire has since verified these conclusions; and it has been found that if the roots of a plant be divided into two parcels, and one of these be plunged into a solution of acetate of lead, and the other introduced into *distilled* water, the latter, after a certain period, will become impregnated with the metallic salt.

The hardiest weed will not grow near the bamboo, and there are plants, such as the 'kelpwort,' that impregnate the soil with alkaline matter; nor do I indeed see how the circulation of the sap could otherwise be completed. The *dietetic* and *medicinal* properties of roots seem connected with this inference, as in the columbo, ginseng, and rhubarb roots, &c. The alternate succession and rotation of crops, and supply of various and repeated nutriment, conjoined with the fact that some plants are destroyed from being near par-

ticular trees, and shrubs, &c., while others, under similar circumstances, luxuriate and flourish, prove not only the exhaustion of the soil, and the process of absorption, but also the *excretion* of materials fatal indeed to some, but adapted as food to others. Mr. Weigmann has entirely mistaken my statement on this question: I never denied the demonstrable fact of the existence of *absorbents* in roots; I only contended there were *also* excretory vessels, assigning, at the same time, my reasons for the belief.

To say that *oysters grow on trees*, is a statement not a little startling, but it is nevertheless true. The roots of the mangrove protrude into the ocean, and oysters frequently attach to their surface; I have seen a portion of the mangrove root with nearly a dozen oysters adhering to its surface; and I have a twig with fine specimens of the *ostrea cristagalli* attached to it.

The stem or trunk is that portion of the tree which has by some been termed the *axis*, supplied with pipes, cells, and filters, and through which the sap rises in its progress to the leaves; part of the stem displays a *vascular*, and the other portion exhibits a cellular structure. The canals are possessed of a vertical arrangement, and traversed by horizontal radii, called also medullary

rays, from their assumed origin, though their source appears to be exterior to the medullary sac. These radii are sufficiently obvious in the cases already cited; some of the cells or internodes, are supplied with *liquid* matter, while *aërial* matter occupies others: these canals and reservoirs, are connected with ascending and descending or returning vessels. Such is the curious and complicated, yet interesting machinery of the stem, though the specific functions sustained by several of these parts be concealed by a veil of obscurity. In numerous instances there are no stems whatever.

Some stems are creeping and run under ground, pushing up here and there a tuft of leaves, as the *agrostis stolonifera*, and common 'couch grass,' the plague of the gardener and farmer. The stems of the strawberry, *linnea borealis*, and *lycopodium, clavatum* are repent, and the paronychita argentea hangs its slender stems adorned with silvery tufts, here and there, over the rocks near Nazareth. Some stems are volubile, or twining, as the hop and honeysuckle, convolvolus and 'scarlet runner.' Some stems climb to the top of the loftiest trees of tropical forests, like immense cables twisted round them; or performing their ascent by claspers, form magnificent specimens of the

cordage of the forest. The various kinds of cissus, or wild vine, exhibit this character, in common with many others. In the 'bush-rope' I have counted four several strands. In the 'Jardin des Plantes,' at Paris, and on the staircase leading to the "Gallerie de Botanique," is the trunk of a tropical tree, embraced by the folds of an enormous climber—the boa constrictor of vegetation.

In altitude or length, and diameter, the stems or trunks of trees present the most varied and contrasted features. According to Von Martius, there is a palm that grows fifteen feet high, with a trunk not thicker than the finger. A comparison, indeed, between the stems of various plants, would in some cases, afford examples of widely divergent extremes. The *scirpus capilaris* is not thicker than a hair, and some are as fine as a gossamer thread, while the trunk of the baobab is nearly 100 feet in circumference. Even canes and reeds in foreign climates sometimes rush upwards to an incredible altitude: Dr. Walsh cut down one of the canes in the Brazils, called with its congeners, 'grass of the thicket,' and it was found to measure ninety feet in length; it was exquisitely polished, and sharply pointed, and "felt lighter than a cart whip." Amidst the dense

gloom of the thicket, and struggling for existence, there is a reed, which, though not thicker than a goose quill, mounts upwards and overtops the loftiest trees of the forests of India. The 'coque,' of Chili threads the woods to an extent of 600 feet.

The greatest altitude of trees in Europe, does not exceed 130 feet; the cabbage palms of tropical climes, however, soar to an altitude of nearly 200 feet, with a stem not exceeding four inches in thickness; they bend gracefully in the breeze, and some escaped the terrific hurricane of Barbadoes, a few years ago, when colossal trunks were levelled with the dust. The vine, in Cyprus, overtops the trees, and attains an altitude of seventy feet. The *pinus douglassii*, on the banks of the Columbia, is calculated to be 250 feet high, and some pines have been reported to attain the goodly stature of 400 feet; an altitude assigned also by Dr. Walsh to some of the denizens of the forests of the Brazils. On the Orocco, the palm reaches an elevation of 180 feet; and the talipot palm of Ceylon is another imperial example of these Corinthian columns of the wilderness.

As to magnitude or volume of trunk, some are truly gigantic, and their branches thickets in themselves. A large black walnut was some

years ago brought from the banks of lake Erie to this country. It measures thirty-six feet in girth, and was excavated and furnished as a sitting room: when I was in its interior, there was a table and several chairs; its walls were papered, and the whole seemed neat, comfortable, and sufficiently capacious. The trunk of a Sycamore was dragged by thirty oxen from the banks of the Mohawk river; its interior is now used as a tavern, near New York. In the interior of a plane, near Constantinople three persons reside, and keep a coffee shop; and in Caffraria, among the branches of that mammoth of the forest, the *adansonia digitata*, are the dwellings of SEVENTEEN negro families, perched like so many bird's nests. The celebrated plane tree in the Greek Island of Cos, once covered with its branches forty shops, and its trunk is thirty-three feet four inches in circumference. Some stems are soft, as for instance those of the aligator apple tree, and the bannana. They thus form a substitute for cork, while on the other hand those of iron wood, cocos, lignum vitæ, &c., are of adamantine hardness.

Exogenous trees are solid; endogenous plants on the other hand, are mostly spongy or hollow, as the *bamboo*, in the internodal spaces of which the se-

creted 'Tabasheer,' or vegetable opal, is sometimes found, and may occasionally be heard to rattle within. In others these spaces are supplied with *water*, which affords a refreshing beverage to the weary traveller. *The cecropia peltata* of the West Indies, has a hollow stem and is employed as a tocsin to summon the labourers to the field, hence the name *trumpet tree*. The *Tilandsia*, or 'water-withe,' belonging to the tribe of the Bromelias, has, strictly speaking, no stem, but there is a substitute for it in the hollow reservoir or tank formed of its imbricated leaves. This catches and retains the condensed dews and rains, and is usually both air and water tight. It forms an interesting provision for tropical animals, as insects, birds, the quadrumana, and other *scansores;* like the cavities sculptured in the tombs in the Necropolis of the Armenians, which are destined to relieve the thirst of the birds that perch among the branches of the *Pistachio terebinthina*. There is, however, another purpose in the beneficent design, for it tends to preserve in virtue of its evaporation, and the geometric structure of the tank corresponds with this, an *uniform temperature* in a medium subject to considerable vicissitudes in a variable and parching clime, as I found the temperature of the water in these living reservoirs, uniform at 68°, though the medium varied from 72° to 80° Fahr.

Besides this singular design, there is another purpose it is destined to fulfil, still more striking and extraordinary, for I have observed that as soon as the ambient air becomes arid, parched, and dry, the overlapping leaves relax on hygrometric principles, and the water escapes and trickles down the grooves of the stem, so that this curious plant literally *waters its own roots*, when it is required; and as soon as the medium becomes moist, the leaves collapse and are at once both air and water-tight. This phenomenon I have witnessed.

Some woods are very flexible and extremely pliant, they bend without breaking, hence the lance-wood employed as shafts for carriages, and I have seen a crossbow from Trinidad, formed of the 'snakewood' almost as flexible and elastic as cane.

The wood of the sandal tree *(santalum album)* rosewood, violet or king wood, pencil cedar, camphor, and aloes, or eagle wood, are sweet scented, or odoriferous; others are fætid, but all are marked by obvious design. The finest specimens of sandal wood come from the Island of Juan Fernandez.*

The *Tamus elephantopus*, or Hottentot's Bread, is a remarkable mass of vegetation; its stem is huge and unwieldy, with delicate twigs protruding. It

* I am indebted to Vice Admiral Page for a specimen from thence.

is three feet high and as many in its diameter, having its surface covered over with angular protuberances, somewhat resembling the shell of a tortoise. Another curious ligneous excrescence is presented in the trunk of the 'cayabouka wood,' called also amboyna wood from its locality, and is represented to me as cemented to the flank of a rock, and to be composed of a trunk without a branch or leaf.

The dodder is composed of a multitude of red thread-like stems, somewhat resembling confused and ravelled filaments, and when viewed interwoven on the furze, at a specific angle in the sunshine, glistens like the gossamer. The cassurina of New Holland is a graceful plant, the stems are pendulous yet leafless.

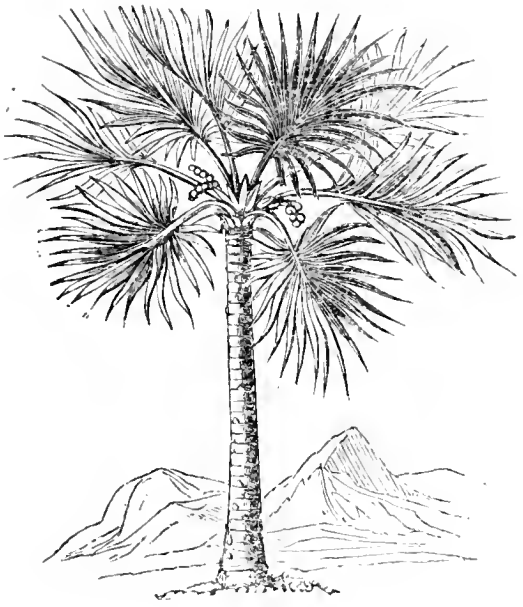
Stems are composed of varied characters, as to their modes of growth. *Endogenous* plants, as has been already stated, deposit a layer of wood internally, and towards the centre. The external cylinder is consequently the oldest and first formed. We find accordingly that the exterior is the hardest or most indurated, as is also the lowest part of the trunk; and it may be repeated, the stem is thus gradually built up, by a prolongation of the fibres of the leaves that are deflected at a specific angle toward the centre. From this view of the case it

must appear that the extension in length of *Endogens* bears no ratio of proportion to their diameter, as is exemplified in the case of bamboos, or the palm. *Exogenous* vegetation on the other hand, annually increase in thickness by the periodic deposit of ligneous matter and of bark toward the circumference. New wood is formed annually and deposited between the external surface of the woody skeleton, and the inner surface of the liber, a fact clearly proved by the experiments of the late Dr. Hope, in the Royal Botanic Gardens of Edinburgh, and since successfully repeated by others. In the case of *nodules* on the beech, a layer of *liber*, or inner bark, is interposed between them and the wood.

Contrary therefore to endogenous vegetation, the central wood is the oldest and firmest, and necessarily the most mature and permanent. Our forest trees supply examples of exogenous growth. In *acrogens*, or such as are supposed to shoot or grow from the top, as in tree ferns, the trunk is a spongy mass with a hard and dark ligneous matter, disposed in convolutions, which is sometimes employed by the native cabinet-makers in inlaid work in the same manner as ebony is used. Fungi, and Lichens, exhibit another mode of vegetation to which the term *centrifugal* has been assigned.

Leaves form a very beautiful attire, and are usually *green*, a tint on which the eye reposes without weariness. Sometimes leaves are single and solitary, and at other times twin, or in pairs; sometimes also they are extremely numerous, as in pinnate foliage: their forms are extremely diversified.

In reference to *size*, the leaf varies from a point to an expansion of immense magnitude. Even a rhubarb leaf in this country has measured fourteen feet in circumferenee. The leaves of the Bojoor palm, of India, have a eireumferenee of thirty feet, with a stalk twelve feet long. I have seen a leaf of the *cocoloba pubescens* eighteen feet in circumference, and the talipot palm, under artificial culture in this country, has produced leaves more than thirty feet in circumferenee; one of these leaves is preserved in the botanie garden of Liverpool, and the palm itself was visited by Linneus when in England. The leaf of the *musa paradisiaca* measures five feet long, by two feet broad at its base; and that of the *corypha umbraculifera*, or great fan palm, exceeds thirty-five feet in circumference; and beneath one of these leaves, a person on horsebaek has been completely sheltered from the tropical rains.



PALMYRA PALM.

The Palmyra palm, *borassus flabelliformis*, attains an altitude of 100 feet, and each leaf will shelter twelve persons. A frond of the ciboa palm is used as an umbrella; and at Manilla, one of the Philippine Islands, a missionary had his dwelling constructed of two palm leaves, where he slept secure:

'Sylva domus, cubilia frondes.'

In Loddiges' conservatory at Hackney, the *pandanus longifolia* may be seen with leaves upwards of fifteen feet long.

In consistency, leaves vary from a gossamer tissue to those of the *paliscourea rigida,* that rustle like parchment in the breeze. Sometimes leaves are bristled with spines, or fringed with hair, like the eye-lash. They are frequently *varnished* on their *upper* surface, as in the camelia, magnolia, and laurel; sometimes, again, they are rough and woolly, and resemble felt, as in the great mullein, and *hermas depauperata.* Though leaves are generally green, they are occasionally brown, and sometimes purple, as in the foliage of the purple beech. Sometimes, again, leaves are parti-coloured; the *caladium maculatum* has spotted leaves; the *goodyera discolor* has different colours above and below, and the abele poplar displays leaves of a snowy whiteness on their *under* surface. The tricolor, *ribbon grass, maranta bicolor, hydysarum pictum,* and various others, supply illustrations. Towards the centre of the foliage of the *mauritia aculeata,* one of the palms, there are alternate and concentric circles of blue and yellow, so that the leaves seem full of eyes, like the tail feathers of the peacock, or those of the argus pheasant.

In the alstræmeria all the leaves are *reversed,* and a twist in the *petiolus* will be found in every leaf; this is also the case with some of the shrubby gnaphaliums of the Cape, and I observed that the

leaves of a peculiar exotic fern were reversed, but they remained so. In the *pleurothalis prolifera*, the infant plant, leaves and root, repose in the bosom of the leaf. The leaves of the *zyllophylla* are fringed with minature flowers, and those of the *cardium cassiobona* are prettily ciliated.

When leaves are unfolded, they form a most essential part of the vegetable structure. The nutriment which is absorbed by the root and rises in the stem, flows into the leaves, where it is exposed to the electro-chemical action of the sunbeam, and in consequence of the change effected here, it becomes fitted for all the purposes of assimilation, and re-entering the body of the plant, by descending or returning vessels, in one relation deposits a layer of wood, and in the other a layer of bark. The phenomena presented in the asciduum of the 'pitcher plant,' seem entirely to corroborate these views.

The leaves of the *amaryllis pulverulenta* are singularly dusted with powder, as is also the under surface of an exotic fern, of a vivid yellow colour. The lower parts of the leaves of the *grevillea serica* are soft and silky, and those of the *protea argentea*, or 'silver tree' of the Cape, are silky, and resemble sky-blue satin, and gleam in the sunbeam like laminæ of silver. The tomentum of

the leaves of the *hermas depauperata* of the Cape, not only supplies the natives with tinder, but may be detached entire, and modelled into caps, gloves, and stockings, and the veining of the leaf imparts a beautiful appearance to them.

Some leaves are singularly elegant, and were not overlooked in the Grecian freize. The foliage of the acanthus mollis is the loveliest grace among the capitals of classic times. Pinnated foliage, as in the acacias and mimosas, is delicate and beautiful, and often extremely sensitive, as in the sensitive and humble plants. The foliage of the *acacia jullibrisin* is sensible to variable sunshine and shade; that of the tamarindus indicus forms a protecting envelope at night, closing over the flower and fruit, and one of the acacias droops its foliage on the approach of a stranger, and thus seems to salute him, a phenomenon which endears it to the Arabs.

Leaves are by no means always of the same form on the same tree; those of the paper mulberry are very various, as is also the case in the begonia diversifolia. The amplexicaule leaves of the *dipsacus* are hollow, and retain a considerable quantity of water. In the common teasle, by the wayside, I have observed four tiers of these folliaceous tanks, supplied with rain water, the lower one containing more than a teacupful.

Leaves are sometimes odoriferous, as in myrtles and their allies. The sweet bay, walnut, and guava, afford examples. The transparent sacs, or vesicles, which decorate the leaves of the ice plant, contain muriate of soda.

Light acts injuriously on the lower, or unprotected surface of the leaf; hence the upper surface is so adjusted that the light falls on it exclusively. Gases, and perhaps liquid matter may be absorbed, or secreted by the under surface of leaves. Some powerfully radiate heat, and this will be especially the case when the cuticle is rough and woolly.

When we view the fabric, or structure of leaves, as developed in their skeletons, a new source of wonder and admiration is developed. The leaf consists of the upper and lower cuticle, and that of the nerium oleander may be separated entire and inflated like a bladder. The leaf of the holly may be parted into four laminæ, consisting of the upper and lower cuticle, and two reticular skeletons, one of which is finer in the mesh than the other. Some of these vascular tissues are forked, and others are feathered; some are parallel, and others curvilinear. The *magnolia tripetala*, *ficus religiosa*, *ontario poplar*, *pothos*, *ficus elasticus*, exhibit beautiful examples of these arrangements, and the last of these has an elegant reticular fringe. The gauze texture of the BANISTERIA ARGENTEA,

and the *erythrina* is extremely compact and minute. That remarkable plant the *hydrogiton fenestrale*, from the swamps of Madagascar, is a *natural skeleton* in its foliage. The leaf is like wire gauze, and the narrow meshes form oblong squares, those adjoining the midrib being wider than the rest. (See plate 1. fig. 8.) The skeleton leaves of the banyan, or *ficus religiosa*, are employed when covered with a transparent varnish, as the *canvas* for the representation of flowers, insects, and birds, which are painted on it: I have noticed the skeleton leaf of the same plant represented on an ancient rupee of Lahore.

Wigwams are often covered with leaves of the date palm, and at Mocha, couches are made of the same leaves, and houses thatched with them. The leaves of palms are employed in the East for a writing tablet, and strips of the leaves of the *corypha umbraculifera* are often seen with cingalese characters. The Burmese shasters are written, or rather *painted* on the same leaf on a ground of burnished gold. The 'ink' is that of the celebrated Burmese varnish tree, the 'theet-see'—*melanhorrea usitata.*

The leaves of the *corthusia matthiola* are, when applied to the skin, a true *rouge*, others are rubefacients of more powerful character. The leaves

of the 'henna,' *Lawsonia inermis*, are still employed in Egypt to stain the nails of the fingers *yellow*, as appears to have been the practice in ancient times, the toe and finger nails of the mummy presenting a similar appearance.

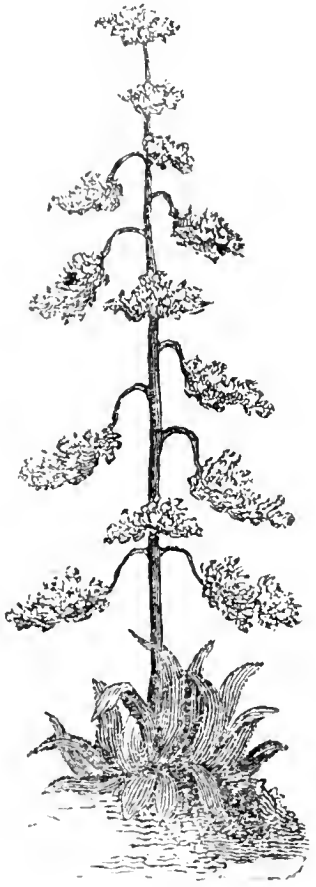
CHAPTER III.

The Blossom—Seed Vessels and Seeds, their structure, &c., auxiliary appendages, glands, spines, pouches, pitchers, traps.

The blossom is doubtless a beautiful part of the furniture of the plant; sometimes iridescent with the tints of the rainbow, it revels in the sun-beam, the pride and ornament of vegetation. The *amhertia nobilis*, with its dazzling canopy of vermillion papillionaceous flowers! the *alpinia magnifica*, *musa paradisiaca*, *strelitzia*, *crinum amabile*, *nelumbium speciosum*, *bilbergia iridiflora*, and myriads more are powerful attestations to the truth of our position.

In respect to size, the blossom varies from a microscopic point to a circumference of NINE FEET; being that of the *Raflesia arnoldi* of Sumatra. The *rafflesia patma*, is two feet diameter, and the flower of the *magnolia grandiflora* is commonly thirty inches in circuit. The *nelumbium speciosum* among the lakes of the Arkansas, as well as the *nelumbium luteum*, (plate 1. fig. 1,) are sometimes twenty-eight inches in circumference,

but which are far exceeded by that gigantic and magnificent flower, the *victoria regina*, of Guiana. The night blowing cereus is sometimes nearly twelve inches in diameter, and the Indian children on the banks of the Magdalena, wear the blossoms of the *aristolochia* for caps; the flowery spadix, of the talipot, or great fan palm, *(corypha umbraculifera,)* is thirty feet long, and bursting from its sheath or spathe, produces a report as loud as that of a musket. I have seen the flowers



of the great American aloe, *agave americana*, (see the figure,) supported by a flower stalk twenty-seven feet high, and that of the *yucca gloriosa* by one nearly as tall. I have a stout *walking-stick* completely ligneous, which was cut from a *flower stalk* of the *musa paradisiaca*, altogether eight feet long.

Though flowers usually unfold under the eye of day, there are many that unlock their blossoms only at 'even tide,' or during the darkness and repose of night: the *cereus grandiflorus* is a conspicuous example, and its beauty vanishes at sunrise. On the 19th of July last, I made some observations on this nocturnal beauty; at eight o'clock, P.M., it began to open, and continued regularly to expand till half-past ten, when it was cut off and carried home, and the lower end placed in water, maintained at a uniform temperature of 98° Fahr. About half an hour after midnight, it had reached its greatest expansion, and displayed a disc of ten inches in diameter, or thirty inches in circumference; it scented the whole apartment with the most delicious perfume, scarcely distinguishable from that of *vanilla;* the temperature of the ambient air from eleven o'clock P.M. to one o'clock A.M., 20th July, varied from 68° to 72°, and that of the flower from 71° 5 to

74°, as ascertained by a delicate thermometer. There is a lovely flower among the forests of India, which soars above the loftiest trees, and can only be contemplated by the moon's pale lamp, for at early dawn it is gone. The cactus septagessima, though paler than its sister cereus, is also nocturnal. The *stellis micrantha*, a native of Jamiaca, continues for eight or ten days successively to unfold its flowers by night, and to shut them as regularly at sunrise; thus do

"The evening and the morning rejoice."

There is another class of flowers that are scentless by day, and yield their fragrance only at 'dewy eve,' or during night. The 'night smelling stock,' *pelargonium triste*, *gnidia imberbis*, *hesperis tristis*, and others, illustrate this peculiarity. These flowers, Linneus, with characteristic felicity, called *flores tristes;* they may be considered to hold the same rank among the tribes of vegetation, as the moths, and 'fire-flies,' and other 'night-faring' animals do in zoology, and to their wants and enjoyments they may essentially contribute.

That the mechanism of the opening and shutting of flowers is connected with, dependent on, and regulated by the temperature, and hygrometry of

the atmosphere, there can, I think, be no reasonable doubt; and indeed the facts may be verified by experiment, as well as attested by observation. Many flowers begin to close towards the decline of the day, and remain shut during night; even the daisy then folds up its petals, and I find that the *eschalotzia californica* closes its flowers at night and opens them by day, though removed from the plant and placed in water. The flowers of some *gnaphaliums*, from the Isle of France, are a tolerably good substitute for the *thermometer*, for I have noticed that they are more or less expanded according to the temperature of the ambient atmosphere. Flowers of the *xeranthemum lucidum*, that were gathered in the morning after a copious dew, were all shut, but during the day, which was warm and dry, became fully expanded. If flowers of the *xeranthemum proliferum*, *ammobium alatum*, *xeranthemum spectabile*, the common "everlastings," and others of the same kind, as well as those adverted to, be plunged into hot water, they will severally close their flowers. The *gnaphalium* and *xeranthemum*, shut almost instantaneously; those of the *xeranthemum proliferum*, are more tardy: when the moisture exhales, and the weather is warm and dry, all these as regularly open again. If the flowers of the

xeranthemum lucidum, when completely shut, are placed on a heated plate, they will rapidly expand. During the great solar eclipse of 15th May, 1836, I found that the thermometer fell from 66° to 53° Fahr., and the hygrometer shewed a considerable deposition of moisture; at the period of the greatest obscuration, all the flowers of the *ficaria ranunculoides* which enamelled the sod around me had completely closed; I collected a few of them in this state, and transferred them to a glass of water, when they all re-opened on the returning sunshine.

Some flowers, it is well known, are remarkably permanent in duration. That class of flowers commonly called 'everlastings,' may be referred to as examples. The flowers of the *cypripedium insigne* and *venustum*, *zygopetalon mackii*, *&c.*, are also long lived; on the other hand, there are many floral beauties that are transient and truly ephemeral; the *convolvolus*, *marica sabini*, the *gum cistus*, and others, belong to this fair, but fugitive tribe. The flowers of the *tigridia* fade after a few short hours existence, and the *morœa tristis*, even with the choicest care, will not survive a period of three hours.

Some flowers change their hues as they advance towards maturity. The *lupinus mutabilis*, *helio-*

ropium peruvianum, *franscia hopeana*, *polygala micrantha*, and various others display this curious mutability. The *heleborus niger*, or 'christmas rose,' is first white, then pink, and finally green. The blossoms of the *lonicera japonica*, are called by the natives, 'gold and silver' flowers, from the mutability which characterizes them in their several stages of advance towards maturity. The *gladiolus versicolor* is a vegetable chameleon; the hues so flit and change before the artist, that he must wait the return of another day, before he can complete his portrait of the flower. The *hibiscus mutabilis* unfolds green in the morning, is afterwards white, about noon it becomes red, and in the evening changed to a rose tint or crimson; all these changes have been found connected with the varying temperature of the ambient atmosphere.

Pliny, with poetic fancy, has called the blossom "gaudium arborum"—the *joy of trees*. At first sight it might be considered only as its simple habiliments, or dress—a gaudy decoration, or a beautiful display; but the results of some hundreds of experiments tend to convince me that there is a beautiful DESIGN connected with all this rainbow drapery—conservative principles, by which the plant is enabled to sustain an equable temperature

amidst the alternations and vicissitudes of a variable atmosphere, such as we find to be the case in the wonderful mechanism of animal life. The individual, or peculiar colour of the flower, possesses its singular, or specific temperature which rises and falls in sunshine and shade. Its absorption and radiation will therefore correspond with the thermo-electric character of the sunbeam. The distribution of colour in the vegetable kingdom will consequently be found to possess its geography on the surface of the globe. White and blue flowers prevail as we advance towards polar regions, or ascend the alps, or pyrenees; "cloth of gold" arrays temperate climes, and a vermillion livery clothes the land of the sun, between the tropics. Each colour, too, has its peculiar season; whites and blues prevail in spring; scarlet flowers chiefly revel beneath a summer's sun, and the autumn's 'sere and yellow leaf' is but a transcript of the yellow flowers that then enamel the carpet of vegetation.

The flowers of the blossom are infinitely varied; some are extremely graceful and beautiful, and others eminently singular and curious. The petals of the *clarkia pulchella* seem to belong to the decorations of heraldry; and the flowers of some species of *aristolochia* might well excite astonish-

ment. The flower of the *oncidium papilio* is a beautiful butterfly when seen at a little distance, and the support of the flower is slender. In the interior of the flowers of the peristeria elata are minature doves with expanded wings. The monkey orchis exhibits a *grinning monkey;* and the *frog, lizard, wasp,* and *spider* orchises are perfect pictures of these animals. The *aceras anthropomorphus* is like a human being from the land of Lilliput. A dog has snapt by mistake at the flower of a *fly* orchis, and children cannot be persuaded to approach the flowers of the *bee* orchis, so perfect is the resemblance. The flowers of some *stapelias,* and those of the *stanhopea insignis, catasetum tridentatum, coryanthes maculata, cynochus loddigesii, &c.* are wonderful even among these miracles of wisdom.

There are some individuals who would endeavour to reason us out of our senses, by telling us that flowers are not flowers, but metamorphosed leaves! and it will scarcely be believed that this modern 'Publius Ovidius Naso,' is not without his neophytes. It is a curious specimen of the inversion of logic—the exception is put for the rule, and the rule for the exception. Flowers, stamens, pistils, fruit, seed, &c. are all metamorphosed leaves! and a plant is a thing of axis and leaves.

This is not very intelligible to the uninitiated; there are plants that are leafless, and yet they flower, and to cite peculiar, or eccentric phenomena, originating in artificial clime, or culture, as examples in illustration of the extraordinary dogma of "morphology," as it is called, is an extravaganza which pertains not to legitimate science, or inductive truth, and it may be reasonably asked, how that can be considered a leaf that never has been one? If this process of reasoning were applied to the organs of animals, and we have certainly no right to restrict the singular assumption to vegetable being, who is there that does not at once discern the folly and absurdity of a proposition so insane! Deviations from the law of order spring from contingencies, and belong to the lists of exception, while the law remains intact. The *agave americana* is fraught with foliage during the entire term of its existence, while it flowers but ONCE and perishes. The *independence* of flowers and leaves is a fact which cannot be controverted. The *sloe* is a milk-white sheet of blossom before the leaves appear, and the almond tree is blossoming before the foliage unfolds. It is the same with the *magnolia conspicua*, and the *daphne mezereon*. The hazel displays the pendant ensigns of its catkins, while the leaves yet remain rolled

up in the cerements of the buds. The flower of the *amaryllis sarniensis* is fading before the tips of the leaves are seen above the bulb. The 'autumnal crocus' unfolds its flowers in autumn, and its leaves in spring. The truth is, the offices, or functions of flowers and leaves are *altogether different*. Chemical processes are eliminated in the leaves connected with the sap and circulation, but the functions of the petals, &c. have to do with the perfection and maturity of the seed. The corolla of the flower absorbs, or radiates, collects, condenses, or reflects heat, &c. Independent of the thermometric expression of the coloured petal, the expansion, or collapse, as effected by the agencies of caloric, moisture, &c. demonstrates that flowers are NOT leaves. The great Linneus said, "The structure of LEAVES is not FORTUITOUS, but destined by an omniscient Creator to answer some particular end." "Abortions," and "degenerations" are twin associations, which with "morphology," may be safely consigned, without any injury to science, "to the tomb of all the Capulets."

The same beautiful chronometry that we witness in the "mechanique celeste" above our heads, may be observed in the periodic inflorescence of plants, and the opening and shutting of the flower, unless

interfered with by disturbing causes. The *ornithogalum umbellatum* expands its flowers at Paris so regularly at eleven o'clock. A.M. that the Parisians call it, *La dame d'onze heures.* The *Papaver nudicale* opens at five o'clock, A.M. at Upsal and Paris. The 'evening primrose,' *œnothera biennis,* opens between six and seven o'clock, P.M. but fades in the morning. It

> "——— shuns the day,
> Blossoms only to the western star,
> And loves its solitary ray."

The same hour at which Linneus had announced the *drosera rotundifolia* to open at Upsal, has been found to hold good in this country, and so on with a multitude of others; hence *floral chronometers* have been formed, and the *anagalis arvensis,* or 'Scarlet Pimpernel,' possesses a flower sufficiently sensible to announce to the shepherd the coming rain, and has therefore been appositely termed the "poor man's weather-glass."

The cowslip is called by the French peasantry, *fleur de coucou,* from its blooming at the advent of the cuckoo; and in like manner the approach of Lent is announced by the blossom of the *melastoma purpurea,* hence called by the natives of the Brazils, Flor de Quaresma, or *flower of Lent.*

Flowers therefore "know their appointed time" and maintain it, unless their chronometry is deranged by the subtilties of art.

The same interesting and curious phenomena are witnessed in the economy of seedvessels and seeds, as in other parts of the Physiology of Plants. Infinite indeed, are they in form and structure: some are singularly chaste and elegant in design, and truly graceful in their symmetry. The circumstances concerned in the ventilation, maturation and preservation of seeds, with the mechanism employed in the dispersion, and planting of seeds, form a *microcosm*, or 'world of wonders' in itself. Some fruits, seedvessels, or cases, are of immense weight and size. I have seen a mammoth gourd, 180 lbs. weight; the double cocoa nut, or *coco de mer*, is also of vast magnitude and weight.

The 'cassia fistula' and 'scimiter cassia,' hang down from the branches from four to six feet long. The fruit of the *telfaria volubilis* is three feet long, and contains imbedded 340 nuts, each the size of a chesnut. The seedvessel of the Lotus is like the rose of a watering pot. The capsule of the poppy is sufficiently elegant, and seems to have been adopted as the pattern of the cinerary urn, and its *somniferous* contents may have contributed to the idea. The Greeks transferred it as an ornament

to the frieze of the Parthenon. The forms of the *hura crepitans* and many others, are equally elegant and interesting.

The shell which surrounds the nutmeg is strapped with a coloured *arillus*, commonly called 'mace;' the *red* arillus of the 'spindle tree,' *euonymus europeus*, curiously contrasts with the *orange* coloured berry which is displayed on the dehiscence of the former. The arillus of the *afzelia* is a *scarlet cup*, while the seed is jet black. The seed and seed vessel of the autumnal, or winter cherry, is not a little singular; the scarlet envelope drops its investing membrane, and displays the berry, resembling a wild cherry suspended from the top of a conical cage of gauze, or network. The *dissipiments* of *lunaria* are curtains of *satin;* the soap berry, *sapindus saponaria* yields a lather, and may be substituted for soap. The seed vessel of the *didymacarpus rœxii* is a spiral plexus, which untwists when the weather is dry to ventilate and mature its seeds, and in moist, or damp weather, it regularly shuts its spiral valves. The tips of the seed vessel of the Fuller's teasle, *dipsacus fulonum* are composed of silicious matter, and well adapted to raise the *nap* in cloth. Some seeds repose among imbricated scales, as in the cedar of Lebanon, stone pine, &c. These scales

are true hygrometers; they severally open as the seed advances toward maturity; in wet weather the seales eollapse to exclude moisture; and in dry weather, when the seeds are ripe, the valves expand, and their eontents fall to the ground.

Some seeds are found to repose in nuts, and others in silk, as the silk cotton tree, bombyx, and the *stapelia*. A pure white silk also envelopes the seed of a tree in wady ghor, called by the Arabs *asheyr*. Other seeds sleep in eotton wool, as the *gossypium*, *asclepias*, and *eriophorum*, and those of the 'doun tree,' of Barbadoes, *acroma lagopus*, are enveloped in 'eider down' of extraordinary elastieity. Some seeds rest on couehes of silk, as the bignonia grandiflora, and others are enelosed in eases of velvet, as those of the 'velvet tamarind.' There are seeds which seem to be surrounded by an atmosphere of their own, as that of the passiflora, whieh I found to possess an exeess of oxygene. Mr. Campbell observed some miee in the desert of Africa nibbling off the berries of a eertain plant, and conveying them to their abode; examination proved them to contain eaeh a teaspoonful of limpid water. Some nuts and seeds are exquisitely polished, and of the most beautiful enamel, as those of the *sagus farinifera*, the bonduc, or nieker-tree, *bonducella*,

coix lacryma jobi, *abrus precatorius*, *erithryna*, and others. Some seeds are curiously carved, and those of the rattan cane are composed of imbricated polished plates. Some are extremely hard, as the *lithospermum*, which resemble small beads of white marble.

The flat seeds of the cassia fistula, which are disposed in septa, are imbedded in a substance resembling in taste and appearance, *Spanish juice*. Those of the 'carob,' and the *adansonsia digitata*, taste like *gingerbread*, and the fruit of the 'milk tree' of Para, like *strawberries and cream!* The fibres which imbed the cocoa-nut are of immense strength, and singularly elastic, forming a cable ('coir') which sustains the shock of a West India hurricane under circumstances where chain cables would snap. Protection from *moisture*, and *insulation* in reference to *variable temperatures*, seem to be the design connected with these remarkable provisions, and many of them contain more bandages than the wrappers of an Egyptian mummy.

Some seeds *creep*, and others *walk*, as those of the *avena fatua*, *&c.*; and some *leap*, as those of the fern; others whirl round, or move an index, as the cranesbill, &c. There are also seeds that *fly*, as the thistle, dandelion, &c.; indeed, some have true wings that move through the air like a

bird, or a butterfly, as those of the mahogany and bignonia grandiflora, (plate 1. fig. 6.) The seeds of the *vaucheria clavata* swim about on the stream, like aquatic insects.

Some seeds possess elastic balls, or air balloons, as the bladder nut, *colutea frutescens*, &c., to aid their transport through the air, and ensure their proper contact with the earth; that of the bladder nut in consequence of one of the cells or *loculamenta* being inflated with air, and otherwise empty, while the other contains a seed, it is evident there will be an interesting equipoise, and its fall will be less sudden, while it will invariably descend with the seed towards the ground. There are seeds that depend in the air from the seed vessel like 'ear drops' or pendants; of this description are those of the *proteas*, of the Cape, that hang by a shaft, sustained at top by a transverse disc, (see plate 1. fig. 5.) The scarlet seeds of the *magnolia insignis*, in like manner, are attached by delicate white filaments, and they thus vibrate like a pendulum, to and fro in the air, and in due time descend to the earth in a parachute. The seeds of the houndstongue, burdock, and others, have *hooks* by which they are fastened securely; I have a curious exotic seed supplied with two sharp and curious hooks, by

which they may be easily and securely suspended, and are thus attached to the bodies of animals, carried to a distance from the parent tree, and planted afar from their natal soil. The seeds of the *tillandsiæ*, carry with them long *threads* which are coiled on hygrometric principles, round the branches of trees where they alight, and they are thus secured from the breeze. The hippuris vulgaris has seeds invested with four threads, which immediately fold up on the contact of moisture. Some seeds are invested with a kind of glue, or bird-lime, by which they are cemented securely to the spot, as the parasitic mistletoe. The seeds of the dandelion have shafts terminated on the top by radiated plumes, which acting on the principle of the wheel and axle, screw them into the ground. The *avena fatua*, or animated oat, has a hygrometric index, which moves round like the hand of a watch, by moisture; it is thus that it grapples with the soil, and if placed in the ground upside down, it will as surely screw itself out again, and adjust itself in a proper position. The seed of the thistle is a plumed globe; the shafts expand by centrifugal action on its escape, and when flying through the air, they collapse when the air is saturated with moisture, and the seed descends to the earth. The seed of the cranes-

bill rolls itself on the ground till the proper position is secured. The structure of the seed of the *stipa pennata*, or feather grass, is very wonderful; it has a plume resembling that of a crane: this preserves its descent to the earth in the plane of the perpendicular; the seed at the lower end is *barbed*, by means of which it retains firm hold of the earth and cannot be withdrawn; the shaft which connects these is twisted like a cork-screw, and resembles catgut; by the hygrometric action of moisture on this shaft, the vertical seed is screwed into the earth to the requisite depth, and the plume having fulfilled its required office, breaks off, and becomes the sport of the winds.

The form of seeds and seed vessels presents every variety of structure, and some are sufficiently singular and fantastic. I have a narrow pod of a South American species of mimosa, which is *reticular*, the parts where the seeds repose being separated from each other by narrow meshes or oblong squares. The seed vessels of the banksia conchiflora, seem studded with specimens of the *mytillus edulis;* and that of the barangtonia speciosa, resembles the quadrangular caps worn by the catholic priests, and the French indeed call them *bonnets carrés.* The cashew

nut is *reniform*, and as it were, agglutinated to the lower end of the fruit. Some seeds are round, some conical, and others triangular, as of the soap berry, the nuts of the betel palm, and those of the *bertholetia*. The seeds of the oleander and cyamus, are true shuttlecocks, *snails*, *caterpillars*, and *horns* resemble the forms whose trivial names they bear. The seed vessel of the *trapa natans*, is very like the scull of a small animal, and that of the *trapa bicornis*, has an accurate resemblance to the head and horns of a buffalo; (see plate 1. fig. 3.) But the most curious of all is the seed of the "snake tree," of Demerara: the shell is thin, and the seed within is precisely similar to a minature snake curled up; and certainly at a few feet distance on the ground might be easily mistaken for a small reptile.

There are plants that actually plant their own seeds, and do not permit them to await the disposal of accident. The *arachis hypogœa* does this; the tips of the branches to which the seed pods are attached, gradually bend towards the earth, and force the seeds into the ground. A similar feat may be observed in the seeds of the cyclamen, which are supplied with a series of spiral coils: even the *nasturtium* has this tendency, and if the soil be friable, or light and

sandy, it will immure its seeds. The seed case of the mangrove contains a viviparous progeny, like the pouch of marsupial animals, such as the opossum and kangaroo. These stretch over the borders of lagoons, or the margin of the sea, the root overhangs the edge of the seed vessel, and the stem is some length before the infant tree whose foliage remains within the seed cup, quits its hold, when it drops into the mud, with the root in its proper position, and the young branches and foliage immediately expand; so that in a *few minutes* there is a tree planted, and in full and vigorous growth: it is thus that the mangrove usurps the space pre-occupied by lagoons, or siezes portions from the dominions of the ocean which eventually becomes an integral part of the land.

The *invariability* of the size and weight of some seeds is also the subject of wonder. Those of the *erythrina abysinnica*, for instance, have been used from time immemorial as the weight of gold, among the Shangalla tribes; it is a red bean with a black spot, called *kuara*, hence the name 'carat,' used as an estimate for the diamond, and other precious stones, being four grains. The seed of the *carob*, is equal to the weight of four grains of corn.

The seeds or sporules of the *lycopodium clavatum*, are extremely inflammable, and when projected against an inflamed taper, flash like powdered resin. When the fruit of the pandanus odoratissimus (?) is ripe, it explodes with great violence, and sometimes inflames spontaneously when dispersing its seeds. The falling seeds of the 'cannon-ball tree,' as they rebound from the earth, sound through the forest, according to Descourtilz, like the running fire of musketry, and the balls, which are perfectly spherical, present an appearance as if military had bivouacked there. "The fallen pericarps," says the late Rev. L. Guilding, "which strew the ground and exhibit the scar or hole by which they were attached to the peduncle, so nearly resemble the cannon shell, that one might easily, at first sight, imagine that a company of artillery had bivouacked in its shade." Descourtilz mentions their sound in falling; "lorsque le silence de la nature est interrompu par les brises violentes, qui sous la zône torride, font souvent le désespoir du cultivateurs, on entend la crépitation des fruits du couroupite dont le balancement produit un choc mille fois repeté, et semblable au feu roulant de la mosqueterie." The capsules of the *hura crepitans*, (plate 1. fig. 2,) or sand box tree, explode

as loud as a musket when scattering its contents, and thus summon the monkeys from every quarter of the forest to the generous board; hence the trivial name applied to these capsules, "the monkey's dinner bell;" there is thus not only a feast in the wilderness, but a summons to the banquet. In one case, I was told, the force of one of these, bursting from humidity, was so great as to blow out a window, and the shell fragments could not be discovered; in another case the explosion roused the inmates of a house from their slumbers. In the seed vessel of the *hernandia sonora,* there is a circular orifice below and the seeds are disposed at intervals, or with spaces between them, so that the tree becomes *vocal,* by the breeze whistling through the avenues of the seeds; it is therefore called "whistling Jack in a box," and a friend informs me there is a valley in Barbadoes, called "Jack in a box Valley," from the number of these trees, and he has often sat delighted in listening to these natural æolian harps strung among the branches, as the zephers fluttered in the woods or swept between the hills. The oxalis disperses its seeds with some degree of force, and the "heartsease" is not a little interesting in this respect; the seed vessel, previously pendant, becoms erect, and thus

the widest and most equable circular range is effectually secured. The reverse position is exemplified in the *lycythis olaris*, or "pot tree," so called from the purposes to which it is applied by the natives; it resembles an Egyptian or Etruscan vessel; it is of adamantine hardness and resists the action of fire; the seed vessel is closed at the top by a very *curious plug*, which accurately fits an orifice bevelled round the edge: as soon as the nuts within are ripe, the seed vessel is turned upside down, the plug drops out, and the nuts are scattered on the ground. Thither the tenants of the forest flock, and I am informed by an individual who has actually witnessed it, that the scramble is a curious one, and what with the screams of parrots and parroquets, the grinning and chattering of monkeys, and the shrieks of other animals, the scene is one of indescribable drollery.

The bursting of the elastic valves of the seed pods of furze and broom in warm and sultry weather, is sometimes very startling. The *balsamina noli me tangere*, and *cardamine impatiens*, have elastic seedvessels which immediately discharge their contents by the sudden collapse, or recoil of their valves, and the contact of a fly is quite sufficient for this purpose. The Dostenia contra-

yerva seed is so sensitive, that the most gentle touch causes it to spring from its socket. I have seen a species of *coccus* on this peculiar receptacle, and the incidental contact of the insect would ensure its expulsion: I have not been able to discover the peculiar mechanism by which this is accomplished. But the most singular of all is the seedcase of the *momordica elaterium*. The seedvessel detaches itself when ripe, with great force from the stalk, and the seeds are by a violent projectile force, discharged through the circular orifice like peas from a 'popgun;' and the impetus is so great that they are sometimes dispersed to a distance of *fifty* feet, and projected over a wall of considerable elevation. There is, indeed no small risque in passing the plant, when the seedvessel begins to turn yellow, and it may beadded with Pliny,--"etiam oculorum periculo." The velocity of their transit through the air is such, that the seeds though previously embedded in a pulpy matter, become quite dry. I have made a great many experiments with a view to discover the principles by which this remarkable expulsion is effected. It is certainly not produced by the disengagement of elastic matter, or evolution of heat, &c., but appears entirely referrible to the consentaneous contraction, or convulsion of the fibres which repose longitudinally,

the extremities of which diverge towards the sides, and each of them grasps a seed. So simultaneous is the projectile act, that we rarely find one seed left behind. There is a parasite or epiphyte among the pines of California, that discharges a volley of seeds in the face of the collector. The anther case of the *catasetum tridentatum*, seems to be very irritable. I was once passing the plant, when it was discharged with considerable force, and remained attached to my hand for a considerable time, moving on its elastic hinge. In another instance it struck a person on the eye, and occasioned temporary blindness.

Tendrils, may be considered prehensile organs, intended to support or assist the plant to climb. The pea, passionflower, *cobea scandens*, and others, possess tendrils. The peculiar tentacula, like appendages observable in the case of the ivy, and somewhat resembling the feet of caterpillars, belong the class of prehensile organs. That they are not roots, neither supply their place, is evident in this, that the plant perishes if the communication with the earth be severed, and no such attachments appear on the stem when it starts from the wall, or overtops the trunk.

Glands are secreting organs, and their secretions are very various; their forms, too, differ consider-

ably. In the *ricinus* they resemble a round-headed nail; in the nectarine they are like a cup supported on a stalk; in the *fraxinella* they appear like dots which stud the peduncle and lower surface of the petals, and emit a highly volatile inflammable vapour, which may be readily inflamed; indeed, I have repeatedly kindled this vapour in the course of a few minutes at the *same* plants. Sometimes the flame has been more than two feet high, depositing much carbonaceous matter, and the plant is not at all *scorched*, or otherwise injured by this repeated combustion; and as I have kindled it by *electricity*, I can readily believe that one class of *ignes fatui* may be reasonably ascribed to some such cause in a high electric condition of the atmosphere: the mossy veil of the moss rose is a lovely form of secreting glands.

Hairs, setæ, &c. are sometimes connected with secreting organs, as in those of the common nettle and the *loasa* of Chilli. The puncture is attended with trivial inflammation in the nettle, but it is more serious in the latter case, and I have suffered from its wound. Considerable caution is necessary, and the allusion is the more important, as both the *loasa nitida*, and *acanthifolia* are named in every seed list, and sown indiscriminately in the garden. I have no hesitation in saying, that the

accidental wound of the loasa might even endanger the life of a child, and the foreman of a nursery in the vicinity of London, had nearly lost an arm from the wound of a loasa. The whole of the loasæ ought to be extirpated from the precincts of the garden. In delicate idiosyncrasies life might be the consequence of contact. The long grey hairs that decorate the *cactus senilis* impart a very antiquated appearance to the plant, and justify the specific appellative *senilis*. The *paliurus* has a waved flexible stem, it is studded with thorns, and from its being common in Palestine, it is not improbable supplied the materials for the "crown of thorns." The *sagus farinifera*, or sago palm, *when young*, according to Rumphius, is bristled with thorns as sharp as needles, being an effectual security against the depredations of wild animals, who are extremely fond of the plant in an early stage of growth, and would soon extirpate a palm which supplies sustenance for thousands of the human race; after a few years the spines fall to the ground, and the tree is then no longer sought for by the wild beasts of the forest. In the *holly* the spines appear so far as the plant is within the reach of cattle, but disappear *above* that line. The spines are sometimes curved, forming *hooks*, as in the *combretum;* in the *malphigia*, the thorns

extend horizontally, and rest on a stalk; examples of formidable spines are found in the *gleditchia horrida.* I am informed that birds have been impaled alive on its spines by accidentally flying against it, and in Barbadoes they are suspended in the houses as traps for the bats, which fly against them, and are thus caught. The "butcher-bird" in this country, sometimes uses the spines of the hedge thorn to impale its victim; and beetles, and other insects, may be thus occasionally found. The spines of the *euphorbia antiquorum,* seem to be an ensign with "noli me tangere" for its inscription, and operate as an interdict to the unwary, its juices being highly acrimonious and corrosive. In the gleditchia horrida the spines are four to eight inches long, and I am informed by a South American traveller, that he has seen the bamboo in the Brazillian forests armed with spines fifteen inches long, and a board struck against them has been perforated to a considerable depth. I have a compound thorn taken from a kind of bamboo in New South Wales, it is five inches long, highly polished, and beautifully tapering, and as sharp as a needle. The *ocacia capensis* is possessed of thorns from two to four inches long; the *hookthorn,* or the *ocacia detinens* of Burchell, at the Cape, is not to be trifled with. Mr. Burchell

had stooped down to collect some plants when these rapacious thorns laid hold of him, and so effectually pinioned him that he was necessitated to call out for assistance, when some Hottentots relieved him from his arrest by cutting away the branches. The natives emphatically call it " stop a bit," and indeed but for assistance the detention may be a most protracted one. The *pterolobium lacerans* is another formidable thorn, so formidable indeed as to impede the march of an army. It is the *kantufa* of Abyssinnia, and the prince of the country, before he commences his warlike proceedings, issues a proclamation for the extirpation of the pterolobium lacerans. " Cut down the kantufa in the four quarters of the globe, for I know not where I am going." Linneus called such plants as were armed with thorns, *milites*, ' soldiers,' and their spines appear to be intended as a protection to the plant, and some plants lose their spines on being cultivated; they serve also as a defence against the contact of the incautious, or imprudent traveller; but spines have also a relation to atmospherical electricity, and the experiments of Astier and others, seem to leave no doubt on the subject.

Pouches and *pitchers* are among some of the most curious provisions in vegetation. The pouched

leaves of the sarracenias have already been mentioned and described. The *discidia* among the tropical forests of India, carry with them leathern pouches to the summits of the loftiest trees, to catch and retain the dews, or tropical rains, and thus supply the plant. In the bromelia tribe, as in the ' water withe ' of Jamaica, we find a tank formed of the imbricated leaves which often contains a considerable supply of water that may be considered a well spring to tropical animals, though it be chiefly connected with the physiology of the plant. The late Mr. Whittaker informed me that he observed, in the desert of Hurrianah, near Bahtinda, a vegetable tank replenished with water held almost sacred by the Bramins, who strictly enjoin that the plant may be *bent*, but not *broken*. In the teasle, the amplexicaule leaves, which are hollow, contain a considerable quantity of water. I have seen four tiers of these leaves, the lower one containing more than a teacupful of water. The *cephalotus follicularis*, (plate 11. fig. 9) a native of Australia, is replenished with bags, or pitchers, which have lids, as in the *nepenthes*, they emerge from the centre, are disposed round the plant, and are altogether independent of the leaves; the lip is circinate, like that of the ascidium of the nepenthes, and in the first instance the lid is hermetically

closed. The pitcher of the *nepenthes distillatoria*, (plate II. fig. 16) is one of the most curious and interesting phenomena of vegetation. It is an elegantly formed pitcher, hung at the end of every leaf, though sometimes separated from it from six to twelve inches, and seemingly connected by a prolongation of the midrib. It depends vertically, a position which is especially provided by its peculiar structure, and there is a loop-hole in the connecting stem which would further secure the position by suspending it on a hook thorn of some adjoining plant. The lower part of the pitcher itself is varnished, and studded with orifices which seem to secrete the liquid that flows into the pitcher; the body of the ascidium is possessed of a lip composed of a circinate series of coils of greatest breadth in front, and separated at the hinge of the lid. This lid possesses a small curved hook behind; and before there are two straps, or processes, by which it is fastened in front, and maintained there for some time after it separates laterally from the lip to admit atmospheric air, while dilution is at the same time prevented. When the latter purpose is completed, the processes in front give way, the lid opens, and the purposes destined by it being now completed, it is filled by the tropical rains, and thus deflected from

the perpendicular, pours its contents on the ground, and forthwith withers away—"the pitcher is broken at the cistern."

The TRAPS attached to plants seem destined to catch insects, and apparently to appropriate them as food, and although there is no semblance of their being *swallowed*, i. e. taken into the system of the plant in a state of integrity, the decomposition of the insect may supply gaseous, or volatile exhalations, of eminent service to the well being of the plant. I am strongly inclined to believe, from repeated observation, that the leaves of the pinguicula entrap minute insects; of the *drosera rotundifolia* there can be no doubt; indeed the plant may be easily recognized by the insects impaled on its leaves; the *hairs* which stud their surface secrete a viscid fluid by which the insects are entangled, they then bend gradually down on the victim till its struggles terminate; in the meantime ceasing to secrete, they then gradually regain their former position. I found at the back of the labellum of the *cypripedium insigne* a small irritable forceps that had caught a fly. The number of insects that are caught by the flower, by the collapse of its central organs, of the *apocynum androsemifolium* are remarkable: I have counted more than thirty in so many flowers on one plant struggling together. The flower of the *aristolochia*

clematitis is also a fly catcher. The ' roridula ' is suspended in the houses at the Cape to entrap flies. The adjunct to the leaf of the *dionœa muscipula* is constructed on the principles of a spring rat trap; there are two lobes that open on a hinge and the edge is toothed or serrated, so that when the lobes spring together the teeth dovetail, or lock into each other. Toward the centre of each lobe, there are three hairs wherein the irritability resides, these are arranged in a triangular form, and when accidentally touched by an insect, the lobes instantly close, and the insect is sure to be caught, nor do the valves unfold till the sufferings of the insect are terminated by death. From the peculiar convexity, &c. in the lobes, they entirely escape being injured by the hairs; the setæ being folded up like the poison fangs in the jaws of the serpent. Viscid exudations are observable in many plants which subserve a similar purpose, as the *ledum*, and some of the *ericas*.

The wisdom of Infinite Intelligence, and a prospective providence are in these remarkable arrangements and adjustments sufficiently manifest. The vain and conceited Buffon caused his statue to be inscribed—

" A Genius equal to the majesty of Nature!"

Sir James Edward Smith, I remember, well remarked, "A blade of grass would have confounded his pretensions;" and certainly the feeblest flower that blooms on heath, or hill, had it a tongue to speak, might have well replied, "THOU FOOL!"

CHAPTER IV.

Relations of Light, Heat, and other agencies to vegetation—Extremes of temperature in reference to Plants—Aquatic and aërial vegetation—The vital principle—Germination.

Light, heat, electricity, and moisture, combined with atmospheric air, or other gaseous media, may be considered as the agencies which operate on vegetation, and affect its phenomena. The results are sometimes chemical, and at other times mechanical.

When plants are placed in the window, it will soon be found that they turn the *upper* surface of their leaves toward the light, and frequently the whole plant will incline in that direction; a circumstance which, while it points out the necessity of *vertical light* to healthy vegetation, shews at the same time, the injurious tendency of unattenuated light to the *under* surface of the foliage. The peculiar structure and condition of the leaf, are in harmony with the inference, since it will be observed that the superior surface is smooth and varnished, as in the leaves of the laurel and mag-

nolia, while their inferior surfaces are unvarnished, and the vascular structure is there more in relief. It is a curious circumstance, that in some of the shrubby gnaphaliums of the Cape, the leaves are reversed, or turned upside down; but this is more especially the case in the various species of *alstræmeria*, where the leaves begin to adjust themselves in obedience to the same law, as soon as they unfold in the bud; and a *twist* in the petiolus, or leaf stalk, will consequently be found in every one of them.

When plants are concealed from the influence of light, or shut up in darkness, they *usually* lose their *green* colour; they become blanched, or *etiolated*, as the French phrase it, as is the case when celery and sea-kale are earthed up, or otherwise excluded from light: hence mint has been found completely white in a deep mine, and cress and mustard raised artificially in arctic regions, in the absence of light, though possessed of their usual pungency, were entirely colourless. The foliage of part of an American forest had unfolded during a considerable period of sombre and cloudy weather, and the leaves had remained pale and almost white, but as soon as the sun broke forth in its intensity, the progressive change to different shades of green was visibly manifest: indeed it

cannot have escaped general observation, that the different intensities of colour in foliage and flowers, correspond with variable sunshine and shade, season and clime.

The attachment of plants to light is sometimes singularly manifested: plants have stretched themselves upwards from immense depths in the clefts of rocks, and overtopped them. A potatoe in a dark and deep cellar elongated its stem, and crept through the key-hole; and another under similar circumstances, climbed upwards between the lath and plaster, and entered by a crevice, a room on the second floor. On the other hand, plants have been discovered in mines *coloured;* I have a specimen of *byssus aurea,* found in a deep lead mine. Humboldt obtained a *green* plant in one of the mines of Freyberg, and a species of *fucus* of a deep green, has been abstracted from a depth of 360 feet, where we infer the influence of light must necessarily have been considerably diminished; the flower of the tulip will also develop its usual colours, though the plant be preserved in darkness.

The *rhizomorpha phosphorescens,* found in the mines of Hesse, in the north of Germany, evolves light, and illuminates the walls of the air galleries; other species of this curious genus, such as the

rhizomorpha subterranea and *aidula*, have been also observed to emit light. The counsellor Erhman has described his surprise and delight on seeing one of the Swedish mines illuminated by this fairy light, these glow worms of vegetation; a person once informed me he was enabled to read a letter by a rhizomorpha's light, in one of the coal mines of Britain. What is called a 'luminous moss,' has been noticed in some of the caverns in the granitic rocks of Bohemia. There is a beautiful little moss, which I presume is that referred to, namely the *schistostega pennata*, that hides itself in some of the granitic caves of Cornwall, and sheds a softened and beautiful light, resembling a carpet of burnished gold, when viewed in a favourable angle of vision; this gleam betrays the lowly, lovely inmate of the cave, on the principles of polarized light.

The structure of a small portion of the moss, as revealed by a powerful microscope, will be seen at fig. 7, plate 1. This most beautiful phenomenon therefore, is connected with peculiarity of structure, and has its counterpart in the emerald gold plumage of the humming-bird, or that of some beetles, and is also exemplified in specimens of the Labrador feldspar, or the precious opal of Hungary. Though the fall from the roof of the

cavern* from previous rains, had rendered the entrance difficult, and somewhat dangerous, I was more than repaid by the beautiful vision of this precious gem of vegetable creation.

Gleams, or flashes of light, have been observed to play over some flowers on sultry summer, or autumnal evenings; the phenomenon was first observed by the daughter of Linneus, on the flowers of the nasturtium, but it has also been noticed on those of the oriental poppy, marigold, and others. During a nocturnal thunder-storm, the disc of a flower at Stowe, the seat of the Duke of Buckingham, remained illuminated amid the surrounding darkness, for some time. The phenomenon, is in all probability, *thermo-electric*, and solar light may be considered generally as an electro-chemical agent, while its calorific rays animate by their warmth.

A specific degree of temperature seems essential to vegetation, yet it is difficult to assign the proper limits which circumscribe her reign. There appear, certainly, lines of demarcation in both hemispheres, to the dominion of plants, but there are, nevertheless, divergent extremes. Even in sterile wastes invaded by 'sandfloods,' there are

* Argol's cave, a few miles from Falmouth.

emerald isles. The burning sands of the Saharra, have their *oases*, or 'islands of the desert,' garnished with mimosas or the palm and the tamarix.

Even streams of lava and volcanic ashes are soon mantled with a living robe of vegetation. In the Island of Tanna, where the volcanic soil was burning hot, the ground was enamelled with flowers; among the smoking debris of the Solfatarra near Naples, I noticed the *arbutus unedo*, *erica cinerea*, and others. Dr. Sçhouw, of the Royal Botanical Garden at Copenhagen, informed me that he had found in one of the main craters of Etna, at an elevation of 14,000 feet above the level of the Mediterranean, an *alga* and a *hypnum*, in a sulphurous vapour, and at a temperature of 98°. A *chara* was discovered some time ago in flower, and maturing its seeds in a thermal water connected with the boiling springs of Iceland. The vitex agnus castus will grow with its roots in boiling water, and the *ulva thermalis*, and some *confervæ*, are found in thermal springs, in some cases within a few degrees of the temperature of boiling water.

These facts are, no doubt, remarkable, as connecting vegetation with elevated temperatures; but the converse is equally wonderful. Polar regions, with their frost-work of icebergs, and their snowy

mountains, are not forsaken. The lichen juniperinum, and lichen rangiferinum, are found in the highest latitudes visited by the daring enterprise of man, and form the food of the reindeer and the musk ox. Kotzebue mentions an iceberg in Behrings Straits clothed with herbage. Decandolle discovered on the *saleve*, near Geneva, snowdrops in full blossom beneath a crystal cerement of ice. Sir E. Parry also observed plants in leaf, and about to bloom in arctic lands, under similar circumstances. At the glacier of Roccosecco, one of the branches of the Berneria, in Switzerland, there is a valley full of ice, which the avalanche has, from time to time, sprinkled with earth; this mountain of ice sustains a great variety of alpine plants, and forms a pasturage for the flocks of Samaden: the "snow-plants" form a feature allied to the same class of phenomena. At Krasnosjark, in Siberia, where mercury has been frozen by the natural cold of the atmosphere (namely, 39o minus zero Fahr.) and Spitzbergen, vegetation maintains her empire. Even in Melville Island plants may be gathered, and an herbarium formed. I have a small collection of plants from the shores of East Greenland, for which I am indebted to the Rev. W. Scorseby.

On the margin of the 'Mer de Glace' I have

culled the roseate flowers of the *rhododendron ferrugineum*, the " rosier des Alpes," as well as the *soldonella alpina*, with its elegantly incised blossom " darkly, deeply, beautifully blue." Then there is the " Jardin," with a flora almost peculiarly its own, far above the glaciers of Talefre—a curious example of a natural garden, verdure, and blossom, in a sea of ice, far above the regions of perpetual snow; indeed, cryptogamic plants may be met with on the surface of the sleeping avalanche.

Electricity is a silent, but a subtile agent, and powerfully influential in the functional developments of plants. It awakens vegetation in the vernal season of the year from its lethargy, supports it in activity, and is connected with its multifarious secretions—chemical mutations are its offspring, and subordinated to its power. The experiments of M. Astier and others, shew very clearly that vegetation has much to do with atmospherical electricity. It is an ascertained fact that seeds and plants germinate sooner, and grow more rapidly, when they are electrified than they otherwise would. A vine grew an inch in an hour during a thunder-storm, and a poplar, struck by lightning, nearly doubled its diameter in the course of a year. I have found the spines of a *gleditchia horrida* discharge the prime conductor

of an electrical machine almost as rapidly as a metallic point, and it cannot be supposed that this formidable armature is inactive in reference to the ambient medium of an electrified atmosphere. Common observation discerns that the vegetation which seems languid and drooping before the coming storm, appears afterwards refreshed and invigorated.

Air and water enter into the constitution of plants, as vehicles, or solvents, and may be assimilated entire, or appropriated as constituents when decomposed. They are absorbed by roots and leaves, and perhaps by other surfaces: leaves quickly perish when their glossy and *upper* surface floats in contact with water, but remain long unfading in particular instances, when the under surface rests upon it. The felt-like, or woolly covering of leaves, called the *tomentum*, has also a distinct relation to moisture, through the medium of *radiation*, and leaves that are smooth, or varnished, are, on the other hand, in this respect, comparatively inert. I have placed leaves of the great mullein (verbascum thapsus) along with those of the magnolia grandiflora, on the gravel walk during a bright nocturnal sky, and invariably found that the former were copiously bedewed, while no dew formed on the latter.

The relations of plants to moisture are very diversified, and extremely interesting; but an example or two, of a peculiar kind, may here serve in illustration. In a preceding chapter, the liberation of seeds from their seed vessels by the influence of moisture has been noticed, as in the instance of the *hura crepitans*. The very opposite effect is produced in other cases; should the seed vessel of the great fig marigold, one of the *mysembranthemums* of the Cape, be open, the segments of the seed vessel would instantly collapse by wet, like the scales of the fir cone, because the seeds of the fig marigold will *not* germinate when moist. The *lycopodium circinale*, or 'Lycopodium of Peru,' (see plate 1, fig. 4) found in arid patches along the shore, or on the flanks of the mountains, in long continued dry weather, collects its foliage together in the form of a round ball, and thus evaporation is considerably retarded. As soon, however, as the atmosphere becomes humid, or rain falls, it unfurls its fronds, and as regularly folds them up again when the weather becomes dry. It does not lose this susceptibility for many years after being uprooted and laid aside.

The 'rose of Jericho,' *hierochuntica anastastica*, is found in desert places in Syria, and in the sandy soil along the coast of Barbary; its tiny branches

securely fold up the seeds contained in cells. The dews of the night seem sufficient for the support of the plant, but in order that the seeds may germinate, it is essential that they be immersed in water. The blast that sweeps over the face of the desert uproots the plant, and it is cast at length on the waters of the Nile, the branches unfold, and the seeds leave their cells; the withered plant, now useless, is wafted toward the delta, and swamped in the embouchure of the river. These seeds germinate in contact with the water, and the lateral impulse of the stream at length conveys them to the margin of the river; some friendly blast wafts them back again to the soil of their ancestry, where they spring up and grow in their 'fatherland.'

In aquatic vegetation, where the leaves float, the air orifices are on the upper surface, as in the nymphea and nelumbium; but in some plants that inhabit a watery medium, there will be found two distinct systems of leaves, as in the water ranunculus; those that are constantly submerged are finely divided, and those that float, or emerge, are more entire. In this class of plants there is a singular analogy to *amphibious* animals, or such as have two sets of respiratory organs, namely the pulmonary apparatus called *lungs*, and the other

termed *branchiæ*, or gills, as in fishes, for leaves are real respiratory organs. Truly amphibious animals, however, certainly compose a limited number, and the *proteus anguineus* of the caves of Carniola, with the *siren lacertina*, and *meopoma gigantea* of the new world, are remarkable examples. Many plants that belong to marine vegetation are affixed to rocks, or cemented to the shells of crustaceous, or testaceous animals, and of course travel with them, but a great many seem vagabond, and float hither and thither, having "no abiding place," and numerous examples have been cited. The *pontideria crassipes* floats in the tanks of India by means of bulbs* that are real buoys. The confervæ are mostly under water, and have narrow, or grass-like leaves. The *conferva bullosa* is rendered buoyant in its foliage by vesicles inflated with oxygen elaborated by the sunbeam. The *callitriche aquatica*, or water star-grass, floats until the period of its inflorescence, when its cells exchange their aërial contents for water, and thus by a change in their specific gravity the plant sinks to the bottom and becomes stationary in the mud. The curious arrangement by which the successively

* I found that the gaseous matter in the inflated stems of pontideria crassipes contained no carbonic acid gas, but more oxygen than in atmospheric air.

prolonged inflorescence of the water crowfoot is preserved above the surface is sufficiently interesting. As soon as the petals drop, the branch is gradually withdrawn from the surface to mature its seeds below; the exchange of specific gravities to suit specific purposes, is not the least singular among the phenomena of aquatic vegetation.

At early dawn the white water lily raises its head above the surface, expands its elegant blossom, and gradually elevates its stem some inches from the water; as the day declines, the footstalk contracts, the flower closes, and it nestles half-immersed during the night. Thus the loss of temperature which the plant would incur from radiation, is compensated for by that of a medium which remains comparatively uniform. This

beautiful phenomenon in reference to the sacred lotus of the Ganges, (see the figure)—

> ‘ Do undoso campo flor.’—
> Flower of the watery plain.

and once, though not now an associate of the “father of rivers”—thence called the rose of the Nile—appears to have been early observed, and is recorded by Herodotus. Perhaps this circumstance, conjoined with other peculiarities, endeared it to aboriginal Egypt, for we find that it crowned their columns, was sculptured in their temples, and associated with their gods. The tubers interwoven with the fibres of the root, as well as the seeds of the lotus, were the food of numbers, and the Egyptian lotophagi hence received their name. The method employed in sowing the seeds of the lotus was very curious, and according to Mr. Royle, in his “ Flora of Cachmere,” is still practised in the peninsula of India by certain tribes. The seed, enveloped in a ball of earth, is thrown on the surface of the stream, where it floats for a few moments, until becoming specifically heavier by the absorption of water, it sinks to the bottom, and in due time the plant rises above the surface, spreads its leaves, and unfolds its flower. It affords a beautiful illustration of a passage in the Sacred

Writings—" Cast thy bread upon the waters, and thou shalt find it after many days." The seed vessel of the lotus resembles half a lemon with cavities that would each contain a small hazel nut; its form is somewhat assimilated to the rose of a watering pot. The pericarpium of the *nelumbium flavum*, (plate 1, fig. 1) gives a good idea of this curious receptacle.

Snakes slumber on the floating leaves of the nelumbium speciosum, and aquatic birds, especially the long-toed Chinese jacana, trip gracefully over them, and sometimes build their nests in the cavities: some aquatics form so dense a mass of foliage and stem as to bear a person walking on them. That splendid aquatic, called in compliment to our youthful queen, VICTORIA REGINA, and represented in the frontispiece, was discovered by Dr. Schomburgh, on the 1st of January, 1837, on the river Berbice, in British Guiana. The flower is composed of many hundred petals passing in alternate tints from the purest white to rose and pink. When the flower bud expands it is white, and pink toward the centre, the pink tint gradually diffuses its glow over the entire disc, and on the following day the whole is entirely suffused with that colour. The flower is *fragrant;* the diameter of this goodly blossom is

fifteen inches, or THREE FEET NINE INCHES in circumference.

The leaf is orbiculate, or salver-shaped, with a broad rim of light green above, and a vivid crimson below. The leaf, in one instance, measured six feet five inches in diameter, and its rim five and a half inches in depth; the ribs were in prominent relief about an inch high, and radiated as if from a common centre; the stem of the flower, near the calix, which is reddish-brown, is an inch thick, and studded with sharp elastic prickles about three-fourths of an inch long. Air cells abound in the veins, leaf, and flower stalk, as well as in the petals adjoining the calix: the seeds are imbedded in a spongy mass in a many-celled receptacle.

But among all the phenomena of vegetation in aquatic abodes, none, perhaps, presents a more wonderful aspect than the *vallisneria spiralis,* (see plate 11, fig. 10 vallisneria spiralis *mas.*) This remarkable plant is *dioecious,* and is, so to speak, a divided being. The roots are distinct and independent, and the plants are sometimes separated from each other, at considerable distances. At a certain period of the year, the two separate classes of flowers, as by a signal mutually given, perfect their buds. In the one plant they part entirely from the stem, mount to the surface of the stream,

and there suddenly expand; they then float about, apparently at the caprice of the stream, and seemingly without the control of design, like snow flakes; the other plant, however, whose flowers are supported on the summits of *spiral* stalks, coils, or winds up in corkscrew form these flower buds from the bottom of the river, where they unfold in the air *simultaneously* with the other floating flower cups. In process of time, its purpose being completed, the flower shuts, and by the contractile spiral fibre is withdrawn to perfect its seeds in the watery medium. This curious and truly interesting plant is found, not only in the tanks of India, (and Dr. Sçhouw told me he discovered what he considered a distinct species of vallisneria in the *fosse* at Milan) but is an inhabitant of the Rhone, and other rivers that are subject to sudden changes of level by an influx of the debacle, or mountain torrent, supplied by the melting of the glacier. The vallisneria spiralis is therefore enabled by this beneficent provision of spiral stems to adjust its flower to variable surfaces. The design is truly wonderful, but "it is of a piece with the rest;" I have found that when the latter plant is insulated, it possesses the property of evolving infant plants which floated around their parent, as in the case of the *pontideria crassipes*.

There are many plants which seem to be more connected with the air than the earth; that curious and beautiful tribe, the *epiphytes*, belonging to the 'orchideæ,' are conspicuous examples; roosting among trees, with their tassels of flowers waving in the breeze and pendant from the branches, they are the ornament and glory of forest scenery. The aloe saponaria, is seen sometimes suspended to the ceiling, and growing in that condition. Colonel Todd describes a teak wood flag staff which he met with in the east, with a banian tree embracing it half-mast high, and its roots dangling in the air; and I have seen a specimen of the *ficus australis* which had been detached from the pot, and was then three years in contact with the roof of the hot-house in the Royal Botanic Garden, at Edinburgh, where it had already carried a crop of figs! I have witnessed also an almost similar phenomenon in the ficus elastica, which grew remarkably well when simply tied, 'root and branch,' to a damp wall.

The lanosœ float about in the atmosphere like spiders threads; "dead will o' wisps," "fallen stars," or "flowers of heaven," names consecrated to their supposed atmospheric origin, are perhaps associated with the *nostocs*. These seem to be

aërial in their origin, and it is not unlikely that skyey regions have peculiar plants, floating through the abyss, denizens of an aërial ocean, and occasionally found associated with meteoric precipitations. There can be no doubt that the atmosphere contains the ova of animalcular life, and other forms of existence; and in all probability the sporules of cryptogamic vegetation, or plants still more minute: a reasonable supposition, and one which will account for many phenomena usually considered as having a somewhat anomalous character. The *red* hail observed by Humboldt in South America, was traced to its association with vegetable being; thus, too, the *yellow*, *green*, and *blue* snow, observed by Baron Wrangel and others. The 'yellow snow' depends on the presence of the *lepra candelaris;* the 'green snow' owes its colour to *palmella botryoides;* and the 'blue snow' to the *byssus cobaltiginea.* The crimson or 'red snow' of the arctic regions, first introduced to popular notice by Sir John Ross, is well known to owe its character to a peculiar plant, namely, the *uredo nivalis,* of Bauer, or the *protococcus nivalis* of Agardh. This plant has also since been found in antarctic regions, for instance New South Shetland. The red snow has also been found in the Island of Lismore, and among the Alps, and

elsewhere in Europe. The indefatigable Saussure discovered it on mount Breven, in Switzerland, and it subsequently occurred so frequently, that he considered it a matter of surprise it had so long escaped the notice of Alpine travellers. Raymond found red snow on the Pyrenees, and Sommerfeldt on the mountains of Norway. In the year 1818, a considerable extent of red snow covered the Italian Alps and Apennines; even the great St. Bernard, where the average depth of snow in winter may be stated at twenty feet, has sometimes assumed the crimson veil. About the year 1808, the snows around Feltri and Belluno were dyed red by the 'crimson snow plant.' Captain Ross estimated the arctic mountains on which the red snow appeared at 600 feet high, and extending eight miles. The depth to which the *uredo nivalis* penetrates, has been variously estimated at from two inches to as many feet; it has been said on good authority, that this plant will only vegetate on snow, and unless connected with aërial precipitation, and perhaps inhabiting a very lofty region, I confess it is to me a matter of no small difficulty to account for it, under the circumstances where it is found: nor is it the mere difficulty that is involved in the question; the position assumed is validated, and

I may add, confirmed by strong analogies. Thus do these extraordinary plants maintain their vitality amid the eternal snows of the highest latitudes, or the loftiest elevations which have been scaled by the daring enterprize of man; and as has been well observed in reference to the crimson snow of the northern regions, "presents to the astonished and admiring navigator a sight more surprising in its reality, than any of the fabled wonders of an Arabian tale."

What the 'vital principle' is, or where it is to be found, I pretend not to know; like its almighty author, 'no man hath seen it at any time,' yet it is the 'punctum saliens' which throbs through the system of vegetation, and the source and spring of all its functions and productions; a dense and mysterious veil, however, conceals it from the hierophant. The philosophy of man has never withdrawn this inscrutable *ens* from the adytum where it remains enshrined. I am aware that an interdict like this is not palatable in these days, when the wit of our philosophy soars so high above *mystery*, and would deny what it cannot solve. This however is not the philosophy which I have been taught, neither does it contain the elements of that of Bacon; it will not do in this case to cut the gordian knot we cannot untie; it

makes the matter worse. It seems to my mind as demonstrable as any problem in Euclid, that the 'principle of life' is one 'sui generis,' *superadded* to organization; some there are who ascribe all the phenomena of life to mere *organization*, or a peculiar arrangement of the ultimate atoms, or *molecules*, as the French call them, and some have ascribed an 'innate vitality' to these atoms; others may whistle to the tune of this dance of dust, and quadrille or waltz of molecules, but I must stand aloof from their eccentricities.

To-day we see the plant a beautiful living thing, arrayed in a vesture of green and blossoming in beauty, unfurling its ensigns to the sun, and all its functions moving in harmony and obedient to the principle of life; to-morrow that plant has suffered an eclipse; there is now a sad reverse, it is a leafless and a lifeless thing: its flowers and foliage are scattered to the four winds of heaven—its "silver cord is loosed"—the principle of life has fled—and the fountain of beauty is dried up. The most exquisitely finished, and most delicate specimen of mechanism, with its varied wheels, pivots, and pinions, superadded to its spring and balance, still wants its compensation curb to regulate its chronometry, and the artist's hand must wind it up; and can we doubt that the master-key that wound

up the machinery of vegetable creation, hangs at the girdle of infinite intelligence?

The "principle of life" is neither *heat* nor *electricity*, nor any other agent with which we are acquainted; it is far more subtile and recondite: these are merely, if the term be permitted, the *tentacula* of its operations; it can sleep for thousands of years in Egyptian tombs and mummy cases, or remain for ages many hundred fathoms deep in the rocky recesses of the globe, or at unfathomed depths in seas and lakes. It can run the gauntlet of fire in temperatures that would scorch or scald; it can live in the crater of the volcano, or in cerements of ice, or a mantle of snow; its identity remains unimpaired through lapse of time or change of circumstance.

These positions, startling though they may seem to be, can be substantiated by indubitable proof; some curious cases have already been glanced at, and a few more may suffice. I took nine seeds out of a *roasted* apple, and every one of them grew; malted barley has grown, and peas, and cress, &c. after being roasted and boiled, were capable of germination, while the seeds of elderberries after being boiled, grew very well. Jessie in his "gleanings" mentions seeds that have grown, brought up from a depth of 360 feet, in

boring for a well, and seeds found in very ancient tombs have readily sprung up. Some seeds were discovered in an ancient British tumulus; they were sown, raspberries sprung up, and fruit has been collected from the plants. A bulb was taken from the withered hand of an Egyptian mummy, and it has since grown; various seeds discovered in these mementos of mortality have grown; some grains of the triticum durum found in the body of a mummy, grew with me, as well as seeds of Indian corn, found in one of the graves of the

Incas of Peru. A plant of the *phormium tenax*, (see the wood cut) in the 'Jardin des Plantes,' which was apparently reduced to charcoal by a conflagration, has risen like a vegetable phœnix from its ashes. An elder, near Matlock, was cut down, and subsequently remained under a stack, where it was consumed apparently by fire; in its after adventures it became a corner post, when it budded, and it is now a thriving tree.*

When a seed is committed to the earth, it absorbs moisture, expands, evolves carbonic acid gas, and in process of time a little plant starts from its dormitory and repose. The rootlet diverges into fibres, which wander in the earth seeking food, these also serve as an anchorage to the plant. The *plumula*, (called in the malting of Barley, the 'acrospire,') or little feather, which is a more advanced extension of that termed in an earlier stage *corculum*, shoots upwards, and becomes the future stem, with its branches clothed with foliage and crowned with blossom; in the germination of the bean all this curious process is sufficiently manifest. The covering, or *testa*, will be observed to rend irregularly by the expansive force of the swelling plumula, and is thrown off

* See "Observations on the Vital Principle," third edition.

as now useless; the lobes, or cotyledons, open as upon a hinge and display the fibrillæ, ramifying on either surface, while the corculum, or infant plumula, is seen suspended between them. In the cocoa-nut, a monocotyledonous plant, the plumula shoots through one of the eyes, and the roots from the others, which ramify on the ball of the shell; in the interior a white, spongy, globular mass will be found attached to the roof of the dome; this increases gradually in magnitude, absorbs the milk, and finally bursts the adamantine shell.

During the development of these curious phenomena, fraught with intense interest to the watchful philosopher, the cotyledons in the first instance, wholly composed of starch or fecula, become saccharine, and this sugar is the earliest food of the young plant; when this resource is at length exhausted, the earth or the air, or both united, is the 'well spring' of supply. Goeppert, of Vienna, found that the temperature of wheat in germinating, rose from 12° to 20°, some kinds from 16° to 26°; maize rose 16°.

Sometimes germination is remarkably rapid. The other day a bet of ten sovereigns was waged between two gardeners of Chelsea, that a *salad* should be reared while a leg of mutton was being

roasted, and $1\frac{3}{4}$ hours was the stipulated period: I understand that the bet was gained, and turnip seed employed, while heat and electricity were the agents. The *bovista gigantea* grows from a point to the size of a large gourd in a single night, and it has been computed that its cellular substance must have multiplied at the rate of 66 millions per minute. A convolvolus has been trained upwards of 2000 feet in one year, in the Caracas. The *telfaria volubilis* is also remarkable for the rapidity of its growth; in one year a plant has covered nearly an acre of ground, and a few plants have been sent to Malta; in three or four years its aspect will be entirely changed, and its naked and arid rocks be transformed into an 'emerald isle.' In less than a month the Pampas of South America become a luxuriant region of thistles in bloom, shot up to the height of ten or eleven feet, and forming an impenetrable barrier that might imprison an army.

CHAPTER V.

Circulation of the Sap—Secretions of Vegetation—Irritability of Plants—Parasites—Epiphytes.

The ascent of the sap is a beautiful process, and though its circulation be a problem of much perplexity, and involved in considerable obscurity, there are, nevertheless, several phenomena connected with it, which reflect some light on its mysteries. The same agencies of light and heat, with their superadded electricities, which in spring rouse the tortoise from its repose, and awaken the dormouse and the marmot from their annual lethargy, stimulate also the functions of vegetation. The *stomata*, or mouths, which terminate the spongioles of the fibre, relax and open; the leaf buds evolve, and the crude sap which has entered the vegetable system, rises through the tubes which replenish it; from these, by means of proper ducts, it is conveyed to the leaves. These leaves are the lungs of living vegetation, where curious and important chemical changes supervene, in virtue of the electro-chemical action

of the sunbeam. Thus stimulated therefore, the sap will, like the march of the liquid in a capillary tube, rush upwards from the root hidden in the earth, to the lofty crown of leaves which decorate the palm of intertropical climes, or the still loftier pines which grace the forests of some transatlantic regions.

Some eminent botanists have ascribed the circulation of the sap to capillary attraction: Mr. Knight seems to refer the phenomena to the action of what has been called the 'silver grain,' those shining plates already adverted to as observable in the oak. According to this view of the case, these laminæ compress the sap vessels, or permit them to dilate; it will however be found a matter of no small difficulty to determine the sap vessels, and distinguish them from the air vessels. The spiral vessels, called also 'central,' from their relative position, are considered by Mr. Knight to be 'sap vessels.' Sap, it should be observed, has been found not only in the cellular tissue, but in the interstices diffused among it. According to Dutrochet, the sap rises through that class of vessels called by Mirbel, 'false tracheæ, and by Decandole, 'lymphatic tubes,' discovered both in the soft and hard wood, and after having been elaborated in the leaves, descends;

those of the radiated tracheæ of the wood, forming *alburnum*, or 'sap wood,' and those of the bark, producing liber, or 'inner bark.' After the crude sap has undergone the chemical changes which supervene in the leaves, it becomes *cambium*, or 'proper juice.'

According to Dutrochet, *exosmose*, or 'outflowing,' arises when *lighter fluids* pass through a membranous septum into heavier fluids, and '*endosmose*,' or 'inflowing,' when the reverse supervenes, or heavier pass into lighter. These principles, Dutrochet applies to the phenomena connected with the circulation of the sap.

The spiral vessels convey, as has been supposed, the secreted juice from the matured liber to the young and extending shoot, previously to the formation of the ascending vessels of the alburnum; at any rate the ascending vessels may be clearly traced through the alburnum into the leaf. By a series of apparently accurate experiments, made by the late Mr. Capper, of Bath, the *alburnum* contains the 'ascending vessels,' and this is generally conceded; but while it has been supposed by some that the *whole of the bark* is composed of the *descending vessels*, Mr. Capper considers that the *liber* and *cellular tissue* contain the permanent *descending* or *returning* vessels, and especially is

this the case in the vine. According to Mr. Capper, the lining of the alburnum, and a peculiar silvery and papyraceous material within each ascending vessel, possess a 'vital principle,' which impels the sap upwards.

All this is tolerably well ascertained, as far as exogenous vegetation is concerned, but considerable obscurity veils the phenomena of circulation in relation to palms, and other endogens; and it is even more perplexed and complicated as far as acrogens, or tree ferns, are concerned, of which indeed, we know nothing.

The power of the ascending sap is very considerable; in the experiments of Dr. Hales, on a bleeding vine, the force of the sap flowing through the orifice, sustained a column of mercury thirty-eight inches high, being five times greater than the momentum of the blood in the great crural artery of a horse. Mr. Braddick's experiment was equally curious: he attached a bladder to a similar orifice; in a few hours it became as hard as a cricket ball, and finally burst with a considerable explosion. The quantity of sap which distils from the orifices of wounds in the birch and sugar maple, in spring and autumn, is almost incredible; nor do these trees seem to suffer materially from the loss. The lactescent juice which

flows from an old plant of the *urceola elastica* has been stated to amount to two-thirds its entire weight. When Bruce wounded two branches of the *euphorbia antiquorum* with his sabre, it was computed that not less than *four gallons* of a corrosive milky sap flowed from these orifices. When the crown of the date palm is cut off, and a cavity is scooped in the top of the trunk, the sap flows into the cavity at the rate of one gallon per day, for the first two weeks; it gradually diminishes, and altogether ceases, in six weeks or two months.

The curious phenomena connected with what takes place in the *ascidium* of the 'pitcher plant,' already referred to, appear to diffuse considerable light on the circulation of the sap; as the changes that are going on in this singular alembic, may from time to time be examined by chemical reagents, and the nature of these mutations be determined. The quantity that has distilled into the pitcher, has been found by Rumphius, and my own observations confirm his remark, to be reduced during the day nearly to one half, which would serve to shew that the sap is inspissated, or increased in specific gravity, from the vaporization of the more subtil or volatile parts; the pitcher is however recruited during the night.

On the same principle does the *nyctanthus arbor tristis*, or 'sorrowful tree,' of the east, recover its drooping verdure during the night. Thus, too, the agapanthus umbellatus weeps from the tips of its leaves, after being plentifully watered, and this takes place during the night; a similar phenomenon is connected with the cala œthiopica. The 'weeping tree' of the 'Missiones,' in the Brazils, it is said, when touched on the warmest day in summer, emits a shower similar to a shower-bath.* In the Island of Ferro, one of the Canaries is a phenomenon of a similar kind, but dependent on principles altogether different: a solitary tree on the flank of a valley, attracts the cloud that seems to emerge from the ocean, and condensing it, the water is discharged in a shower from the foliage into a tank below; hence it is called the 'fountain,' or 'raining tree,' This is measured out by the insular authorities to the inhabitants, who drink of it, "themselves, their little ones, and their herds, and their cattle;" and it seems indeed to be almost the only source of supply. Some kinds of bamboo, and also of cissus, have their internodal spaces replenished with a pure and wholesome liquid.

* I do not know whether this is allied to, or identical with, the 'cœsalpina pluviosa,' which excretes liquid matter so rapidly from the tips of its leaves, as to resemble a shower of rain.

Two vines placed without, in separate vessels of water, had not expanded their foliage when one of the stems was introduced into the hothouse; here it soon expanded its leaves, and the water in the vessel was proportionably absorbed. The other vine remained as it was, and the water had undergone no diminution. From these facts it would seem obvious that the effects are somewhat similar to what occur in the phenomena of the œthrioscope of Leslie. It ought to be observed, that in order to complete the circuit of the sap it is necessary that there be some provision for the superfluous elaborations, or the *egesta* of the plant; and I am of opinion, agreeable to previous remarks, that these excretions are evolved from the lateral fibrillæ of the root.

Independent, however, of the great annual circulation of the sap, there appear to be specific and local circulations, confined to particular parts of the plant, which enable us to account for the growth of slips and cuttings, as well as the processes of grafting and budding. Thus in the joints of the *chara* and *nitella*, also the plantain, where from the transparency of their stems the internodal circulation may be seen by the microscope: the liquid appears to move in a spiral direction, in reference to a central axis, being in an

upward direction on one side, and downwards on the other. The same singular phenomenon may be witnessed in the cells of the *hydrocharis morsus-ranæ*, or ‘ frog-bit.’

The secretions and excretions eliminated by plants present a wide field for research and investigation. These, with the proximate, or immediate parts of plants, come more immediately under the cognizance of the chemical philosopher, but still belong to physiology.

Silica is elaborated by many plants, as in the calamus rotang, and equisetum hiemale. The polished surface of the bamboo is composed of silica, hence pieces of cane struck together in the dark elicit sparks ; the tips of the dipsacus fulonum, or fuller's teasle, are also silicious. The *scleria grandis*, from the presence of the same principle, cuts like a knife. The *tabasheer*, or vegetable opal, is a silicious product; perhaps the DIAMOND itself is of vegetable origin. In many hard woods there seems to be an approach to the adamantine state; and it has been mentioned that the grass of the field has an epidermis composed of flint. A mass of wood stone was obtained from a log of ‘ teak-wood,’ *tectona grandis*. A considerable group of crystals of *oxalate of lime* were found in an old plant of the *cereus peruvianus*. *Camphor* is obtained

from the laurus camphora of India, where it graces the banks of rivers, and exhibits an altitude from fifteen to fifty feet, with a trunk twenty feet in circumference. The camphor of Sumatra is sometimes found in considerable masses in cavities of the bark of *dryobalonops camphora*. The highly inflammable vapour which is secreted by the flowers and seed vessels of the *fraxinella* seems to me to be allied to camphor. *Carbonate of lime* is found in the sap of the vine. It assumes, indeed, a semi-crystalline character in the cavity of a specimen of wood from Africa, in my possession. This secretion is particularly remarkable in a species of wood of a mahogany colour, allied to the preceding, from Sierra Leone. The cavities, or tubes, are filled with a yellowish carbonate of lime; and the quantity secreted by the chara, and deposited is very considerable. Sulphate of lime is found in wheat; the phosphate of lime in the oat; and the nitrate of potassa in tobacco and the sunflower. In the crithmum maritimum, or rock samphire, and the *salicornia*, or glasswort, I found muriate of soda and iodine, and in the ice plant, muriate of soda, iodine and bromine. Bowditch, in his mission to Ashantee, describes a kind of cedar which transpires a saline liquid that crystallizes. Each little plant of the saline basil of

Chille affords daily an ounce of pure salt, though at a distance of, at least, sixty miles from the sea.

Benzoic acid is the product of the laurus benzoin, but it has been found within the shell of the Tonca bean, and the fragrance of new made hay has been ascribed to its presence. I have found it entirely pure in red cedar. The peculiar fragrance of vanilla seems to me entirely distinct: I have a seed pod of vanilla with numerous transparent acicular crystals on its surface: that of the aloes, or eagle-wood of the East, has a fragrance participating somewhat of vanilla.*

Gums are generally secreted by the bark, as the cherry, plum, peach, and others. Gum arabic is obtained from the *acacia vera*, and gum senegal from the mimosa. These various gums are, chemically speaking, not materially different. Gum tragacanth is the produce of astragalus tragacantha. Gum olibanum, the frankincense of old, seems to be obtained by wounding the leaf of the boswellia dentata of Roxburgh.

The hymenœa courbaril affords the resin called gum anime, and gum labdanum is obtained from the cistus creticus. In Crete this plant is whipped

* I have a piece of glass from one of the ancient windows of St. Cross, near Winchester, completely corroded and furrowed by the secreted matter of the *lichens* which invested its surface!

with thongs, to which the gum attaches, and is scraped off. In the time of Dioscorides it is said to have been combed off the beards of the goats which fed on the shrub. Gum dragon is the produce of the dracena draco, or dragon's-blood tree.

Manna is obtained from the leaves of the ornus rotundifolia in the Calabrias; it transudes from the leaves, and is scraped off. Manna is also collected from a kind of tamarix, namely, the *manifera*, called by the Arabs, 'turfah;' it grows near Sinai, and is only found on the borders of the desert. It is of the size of a small pea, and of a pale yellow colour. Manna is also the produce of the 'alhagi maurorum.'

Sugar is elaborated in abundant instances, as in many roots, such as beet, carrot, parsnip, and others; and the first of these, as obtained from cultivating the *white silesian* variety, on the continent of Europe, there competes with colonial produce, namely, that of the sugar cane. The acer saccharinum, or sugar maple, is one of the chief sources of supply in North America, from one to two millions of pounds being annually obtained from this source. The flowers of the asclepias syriaca, rannealmia nutans, hoe carnosa, and strelitzia reginæ, secrete a considerable quantity of

saccharine liquid; but in none of these is it exceeded by those of the rhododendron arboreum nepaulensis. In the flowers of the rhododendron ponticum the sugar is sometimes found in a crystalline form, and 'sugar candy' has been abstracted from them.*

Oil is abundantly found in vegetation; the olive berry is a familiar example, and hence called the 'oil-tree.' The 'camelia oleifera,' the 'oil-bearing tea plant,' of the Chinese, affords another instance; the oil is obtained by expressing the seeds in the manner of obtaining olive oil.

Wax is obtained from the berries of the candle berry myrtle: candles are made of the wax obtained from the wax-tree of Guiana;† and the surface of the wax-palm is covered with a layer of wax.

Butter is obtained from the 'shea,' or butter tree; it seems to belong to the order of *sapotæ*, and grows in abundance all over Bambarra. This tree resembles the American oak, and its kernel is not unlike the Spanish olive; this kernel is enveloped in a sweet pulp under the rhind, and the butter is

* I scraped off a specimen of fucus detached from a rock in the Channel Islands, a snowy white substance, completely saccharine, somewhat in appearance like benzoic acid, or amianthus.

† I have a candle made from this wax, it is yellowish in colour, and seems to have been taken from a mould.

prepared by boiling the kernel in water. "The butter prepared from it," says Mungo Park, "besides the advantage of its keeping the whole year without salt, is whiter, firmer, and to my palate of a richer flavor than the best butter I ever tasted made from cow's milk." Then there is the *tallow tree*, and the 'soap berry,' *sapindus saponaria*.

Caoutchouc, or Indian rubber, a material of extensive importance in the arts, and not only separated into thin sheets and formed into threads, but converted into PAPER, and printed upon, is obtained from a variety of sources, as the *urceola elastica*, of Palo Penang, the hœvea caoutchouc, and jatropha elastica; but the ficus elastica, the source of that we obtain from Mexico, yields, apparently, the best. The West India planters are now extensively cultivating the hœvea guianensis; many hundred tons are annually imported. Its application is truly diversified, is daily extending, and its value more and more appreciated.

There are various secretions worthy of more detailed notice than can be awarded them, and two of these have engaged my particular attention. The first in order is the *coryanthes maculata*, a native of the Brazils, and belonging to

that extraordinary class of plants called *epiphytes*. In this remarkable flower, which refuses to open during cloudy and gloomy weather, there are two glands, sufficiently conspicuous, from which a secreted liquid perfectly limpid and colourless is incessantly distilling, day and night, for the space of about three days, when the temperature of the air is considerable; the discharge is from the tips of the glands into the labellum or pouch, and as soon as it reaches a certain level, the superfluity flows away by means of certain ducts provided for the purpose. By appropriate chemical tests I discovered it to be a *supermeconate* of *morphia*, and I was led to suspect this both from the taste and smell, which precisely resembled OPIUM.

The late Dr. Edward Turner having stated that the fluid in the *ascidium* of the pitcher plant yielded, on evaporation, "crystals of superoxalate of potassa," I have merely to say that in the very considerable number of analyses which I have made of the liquid abstracted from unopened pitchers; lime water, and chloride of platinum gave indications of neither the one nor the other of these ingredients; muriate of soda, malic, and other acids, and chlorophyle, were the exclusive contents of the liquids of these pitchers. When the lid of the pitcher opens, from the consequent

contact of the atmosphere however, a more decided degree of acidity is soon manifested.

The far-famed 'cow tree,' or *palo de vaca*, so interestingly described by Humboldt, is perhaps altogether one of the most interesting and extraordinary productions in the kingdom of vegetation. A complete account of the cow tree has already been published, with a fac simile of the original sketch of the tree, taken on the spot, by Sir Robert Ker Porter;* this renders particular description unnecessary: it contains *albumen*, *gum*, *resin*, *&c.*, and a substance approximating in some of its characters to *gluten:* it is a stately and noble tree, and is represented plate II. fig. 11. The milk trees of Para and Demerara seem to be very different.

We turn now to secretions of a more formidable and lethal character. The poison trees of Java, (see plate II. fig. 14,) legend and fable have invested with features of the most terrific kind. It is now known that the *upas antiar*, and *upas tieuté*, are the poison trees of Java, and their active principles reside in a chemical product, called *strychnine*, which has also been discovered in *nux vomica;* it is from the juices of the upas

* 'A descriptive account of the Palo de Vaca,' &c. second edition, royal octavo, Relfe and Fletcher, London, 1838.

that the natives obtain at least one of the ingredients of their arrow poison. It appears probable however, that the poisonous characters of the upas have been confounded with the "valley of death," in that island, where the bleached bones of man repose with those of animals, savage and tame, and the destructive effects of which seem to be owing to the presence of carbonic acid gas.

The tanghen or tanghina, (tanghinia veneniflua of Madagascar,) is a poison much more formidable than the upas of Java, and indeed seems to be the swiftest and deadliest of poisons. The poison seems to reside in the kernel, and it would appear that a tint of *redness* characterizes the nut when its powers are most deadly; one kernel will destroy many lives, and this active poisonous principle has been called *tanghinine*.

Almost all plants when consumed yield alkaline and earthy matters; even metals have been discovered in their ashes; such as oxydes of iron, and manganese, and sometimes even particles of gold.

Irritability, and what has been called 'sensation' in plants, belong to the same curious class of phenomena. The little green globules observed by Dutrochet in the sensitive plant, have been referred by him to a rudimentary nervous appa-

ratus; this however seems to me to be an invalid, or at least, a premature conclusion. Both mineral and vegetable poisons however, seem to act deleteriously on vegetable life; at least *generally*, for some seem to be equivocal, or altogether, inoxious, since acetate of lead did not seem to effect the vital functions of a willow, but the reverse; and I have applied arsenious acid in some cases without the slightest injury to the plant.

The phenomena of irritability are remarkably exemplified in some particular plants. When a lettuce is in flower, and its surface is touched, a lactescent or milky juice exudes from the spot. The stamens of the *rue, berberry, parnassia, pellitory of the wall, schizanthus pinnatus, mimulus,* and others, when touched with a pin or bristle, exhibit considerable irritability, and they will recede, or spring forward, or collapse, with a greater or less degree of force. The *oxalis sensitiva,* and several others, present similar traces of irritability. The valves of the flower of the asclepias syriaca, are irritable, and retain flies like the apocynum: this irritability seems to reside in a spot not larger than a pin. The pinguicula, or butterwort, will curve inwards almost immediately after it is gathered, and I find that a similar phenomenon takes place with the flower of the *dorstenia contrayerva.*

I have also discovered that the style which supports the stigma of the rannealmia nutans, bends from its reflex position in the cleft groove of the twin anther, commencing towards evening, and in twenty-four hours forms a complete semicircle, bent under the lower surface of the anther; and this occurs even when the flower is separated.

Those peculiar viscid or glutinous secretions that are formed on the catchfly, ledum latifolium, and the roridula, though not connected with irritability, seem to subserve a similar purpose in the economy of the plant. In the stylidium, the lengthened column reclines, when at rest, over the corrolla; but the instant it is gently touched, it starts from its repose, and swings over to the other side.

Pinnated foliage is very susceptible of light and shade, such as the acacias and mimosas. The leaves of the oxalis crenata, collapse towards evening, and similarly formed leaves are equally susceptible of repose.

There are, however, four plants, in which irritability is most conspicuously displayed, namely, the desmodium gyrans, or 'moving plant,' from the banks of the Ganges, the dionœa muscipula, the mimosa sensitiva, and the mimosa pudica, and to these may be added the mimosa prostrata;

which last, when the weather is warm, is nearly as susceptible as the mimosa pudica, or 'humble plant.' The dionœa muscipula and its traps, has already been described.* If a leafet of the humble plant be touched, however gently, the various leafets collapse one after another, and at length the entire leaf-stalk declines from the horizontal position, to the vertical plane; after a certain period the leafets unfold, and the leaf-stalk resumes its former position; this last is its wakeful position, the former that of its repose.

The desmodium gyrans has been mentioned, and some of its phenomena described. They are certainly among the most wonderful of the phenomena of vegetation, nor are there any that I have contemplated with more wonder and delight, both by night and day. On the night of the 21st August last, about eight, P.M., the large leaves of the 'moving plant' maintained a vertical position, but on the morning of 22nd, they had risen to the horizontal plane. The chief, if not entire motion, which in some were almost unintermitting, seemed to reside in the leafets, or stipules at the base of the leaf, of which there is one on each side. These stipules have a spontaneous

* When the trap is closed, it will be perceived that it is *convex* on one side and *concave* on the other.

tremulous movement, performing a gyration, or rather vibration, including almost a semicircle. The adjoining central leaves on each side, seem to rise and fall by the vibration of the stipules like the 'dead escapement' of clock-work. When the pendant leaf is in a state of repose, the *vis inertiæ* is so powerful, that it would require a considerable weight to raise it to the horizontal plane.

Parasitic plants are a curious race; some prey from first to last on the vital juices of the tree, which finally, in some cases, becomes their victim. The diseases which occasionally attack the ear and culm of barley, wheat, and other grain, called *smut*, *rust*, *pepper*, and *dust brand*, and the like, are all phenomena connected with parasitic attacks of minute cryptogamic plants. The *secale cornutum*, or ergôt, which attacks rye, such being called 'spurred rye,' is of the same kind.

The parasite termed *rhizoctonia* which attacks the roots of lucerne and saffron, is so fatal to the latter, that it is called 'mort de saffron.' The *orobanche* is a parasitic plant, one species of which attacks the roots of hemp, and proves destructive. The orobanche major is found parasitic on the roots of the broom, but it is said not to attack those of the furze. I have found it on

the roots of the ivy; the seeds of the dodder are not unfrequently mixed with Dutch clover seed. It attacks lucerne and trefoil, and is found on the hop, nettle, beans, and furze. The dodder commences the term of its existence in the earth, and breaks off this attachment as soon as it has fastened on some neighbouring plant, on which it thenceforth subsists entirely.

The misletoe, the sacred branch of the Druids, and perhaps the 'golden bough' of Eneas, is a well known parasite, especially in the orchards of Herefordshire and Gloucestershire, where it may be seen perched up in almost every tree. It is also found on the hawthorn, pear, mountain ash, and I counted seven in a Lombardy poplar. In this country it is rarely found on the OAK, but when discovered thus associated, seems to have been highly prized by the ancient Druids. It is stated by Mr. Royle, however, that its occurrence is not unfrequent among the branches of the oak in the peninsula of India. While the true mistletoe, *loranthus europeus* flourishes on the oak among the mountains of Arcadia, our mistletoe, *viscum album*, takes up its abode on the silver fir, in the climes of classic Greece. The mistletoe thrush, plants its berries, and disseminates its vegetation.

That curious plant, the *lathyræa squamaria*, seems parasitic on the ash. Its livery is pale and sickly, and of a cadaverous hue; it is usually found growing on the roots of the ash, and the last time I found it was, under these circumstances, in the woods of Bolton Priory, near Skipton. I have, however, seen it grown in the open garden. This plant is entirely dispossessed of leaves, but is clothed with imbricated scales, which have some resemblance to the human teeth, hence the English name 'toothwort.' The most remarkable among all parasitic plants are those exotics, the RAFFLESIAS, which are found on the stems, or roots of a species of wild vine, or on those of kindred plants, usually the *cissus angustifolia* of Roxburgh. The rafflesia arnoldi is a mere flower, covered, when unexpanded, with bracteæ, but entirely void of leaf, stem, or root. This titan, or brobdinag flower, is nine feet in circumference; the five petals which compose its disc vary from $\frac{1}{4}$ to $\frac{3}{4}$ of an inch in thickness. The *nectarium* was computed to hold twelve pints, and the entire weight of the flower to be fifteen pounds. The rafflesia patma is not so large, but measures six feet in circuit.

Among parasitic vegetation presented to us under various forms, none seems to be more

remarkable than what has been called the vegetable, or ‘ vegetating fly,’ or ‘ vegetating wasp,’ of Guadaloupe. The insect is discovered sometimes so oppressed with vegetation, that when it falls to the ground it can scarcely recover its equilibrium.

M. Ricord observed that the greater number of a particular colony of wasps in Guadaloupe, were clothed with this singular armature. The plant in question seems to be the *spheria entomorbiosa* of the English botanist, and appears to “ grow with the growth ” of the insect, and “ strengthen with its strength.” Its rudiments, it is stated, have been traced to the ovum, and through the intermediate stage of the larva to the imago. In a specimen in my possession, (see plate 11, fig. 13) the arborization is forked, and more than an inch and a half long.

But there are plants found on plants that are not *parasitic;* that is to say, they are merely indebted to the tree where they take up their abode for a ‘ local habitation.’ They are aërial plants, and the tree is their dwelling place; they nestle there like birds that ‘ sing among the branches,’ only they do not flit from place to place. Such are called by the name *epiphytes;* their number is immense, and discovery is still adding to the list, and enlarging their boundaries.

The *tillandsia usneoides* is one of the number, and exhibits a profusion of long pendant fibres. It is commonly called ‘ spanish grey beard,’ and is woven into matted cloth. The ‘ water withe,’ another of the tillandsias, already described as watering its own root, is epiphytic, as well as that truly wonderful and extensive tribe of orchideous plants—a beauteous assemblage and noble array which it would require volumes to describe; such as the oncidium papilo, scarlet air plant, catasetum, cattlyea, cirrhea warreana, stanhopea insigne and grandiflora, coryanthes maculata, cynochus loddigessii, and myriads more of these miracles of flowers, of which the ‘ organ mountains,’ of the Brazils, and other parts of South America, and the forests of India, have furnished so rich and copious a supply, just as if they had fallen from the sky, diadems for these forest kings on their coronation morn. Even an amaryllis has been found perched among the branches of a lofty tree.

Peristeria elata is not the least wondrous among these floral gems. The interior of the flower is an exact minature of a dove with expanded wings. A South American traveller informs me he has cut down a flower stem twelve feet high. These flower stems are carried in religious processions. The uncoloured flowers are more beautiful, and

perfect in their resemblance, than the coloured ones; they present the complete resemblance of minature doves, modelled in wax, and are sometimes scooped out and put into a shallow dish as objects of curiosity.

CHAPTER VI.

Eccentricity of Vegetation—Physiognomy of Plants—Geographical Distribution and range—The Geological Relations of Plants—The Size and Age of Trees—Permanence of Vegetation.

Plants are distributed with a liberal hand, and their dispersion, though sometimes curiously eccentric, is nevertheless fenced in by wise and beneficent laws. Their arrangement and relation to altitude and latitude have specific lines of demarcation; and though it be true that there are fences and circumvallations which plants cannot overleap, yet we meet with the phenomena of vegetation under circumstances and conditions not a little startling to our prepossessions. Few, indeed, are the circumstances under which vegetation does not appear in some shape or other.

Plants inhabit the coral caves of the ocean, or float incumbent on its waves; they dwell in the deepest mines, or tenant the darkest caverns; they hide themselves in the clefts of the rocks, or mantle with their foliage and their flowers, the lake, or the savannah, the forest, or the jungle. Even the burning sands of the desert have their

'camel thorn,' and the 'rose of Jericho;' snowy mountains and icebergs have a peculiar vegetation, and boiling springs, and volcanic craters, possess congenial plants.

The mouse-skin byssus may be seen attached to the roof of the vault in wine cellars, and I detached a specimen from the cork of a bottle containing ale half a century old. Byssinæ clothe the damp wall or the external surface of the flower pot with a verdant tapestry. The hygrocrocis is found on paste, in gum water, isinglass, ink, treacle, rose water, and vinegar. Dr. Fleming found a jungermania in succinate of ammonia; a conferva has been found in muriate of baryta, and I have discovered confervæ, not only in hydriodate of potassa, but in arseniate of potassa.

Fuci and algæ grow, not only on rocks, but on the backs of crabs, lobsters, and other crustaceæ. Sea weeds attach to the copper sheathing of ships, and to iron chains, as well as to shell fish. Confervæ have been found growing on the eyes of a perch, and fish sometimes exhibit vegetation growing on various parts of their surface. The byssocladium fenestrale will grow on glass, and vegetation has insinuated between the glasses forming the achromatic lens of the telescope. The biatora decipiens will vegetate on iron. The mis-

tletoe will sprout and grow on a eannon ball; and one of the tillandsias is tied to the iron balconies of the houses in South Ameriea, and succeeds very well under such eireumstanees: I once found a *rumex* growing in oxyde of iron.

A peeuliar kind of fungus is found growing on the hoofs of horses. Deeandole diseovered a group of mushrooms among old rags, and fungi have started into being in the tobaceo box. The *pietra fungaia*, or mushroom, yielding stone, of the South of Italy, is equally eurious in its way.

In wine eellars the *merulius lacrymans* may be sometimes observed to clothe with its snowy vegetation the timber to a depth of several inehes. The ruins of the Colliseum at Rome, are decorated with several hundred speeies of plants, and the *trichia polymorpha* has been found on the dome of St. Paul's eathedral. Vegetation soon eommenees its reign on volcanie lava, and the erupted ashes, and the short-lived island which lately rose in the Mediterranean had already displayed a few plants. An alga and a hypnum have been, as already intimated, found in one of the eraters of Etna, and the snow plants have also been referred to.

Humboldt discovered plants in dark and extended eaverns in South Ameriea, scareely to be reeognized

from their altered condition, and no doubt the offspring of seeds carried in thither by the birds. I have fungi and the *byssus aurea* found in a deep lead mine; and in the galleries of the Freyberg mines, Humboldt found the *plantago lanceolata*, *poa annua*, and *compressa*, wallflower, and *rhizomorpha verticillata*. These plants were *green;* indeed a bright grass green *fucus* has been fished up from a depth of 190 feet—facts which tend to prove that colour is *not* the exclusive gift of light.

The *lichen jolithus* imparts blood-red stains to the pebbles at the bottom of St. Winifrede's well in Flintshire. Thistles have grown to an extreme length in water pipes underground. The *senecio vulgaris* interrupted the flow of the water in the conduit at Hampton Court Palace, and the matted and felt-like roots of the same plant, by their expansion, burst the water pipes which supplied the town of Lanark, in Scotland. The water wheels put in motion by the water flowing from the spring at Holywell, are clothed with a tapestry of moss.

The *boletus igniarius* clothes the bark of the oak with its velvet tissue; and the lowly flags called 'time stains,' and the 'lichen grey,' have sometimes a legend and an inscription, which, if rightly interpreted, is of considerable importance.

We are apt to associate these aërial flags among the lowliest of the train, with 'time long elapsed;' hence the epithet we assign them; it is, however, at length discovered that when rightly deciphered by the cryptogamist, they yield practical information of considerable value. They are truly the *literæ scriptæ* of creation, and graphic lichens inscribe on the bark of trees, in curious hieroglyphics, its comparative officinal, or medicinal value—its worth, or worthlessness. Some lichens are attached to particular officinal barks, and are not found on others; some are, in like manner, only found there when the officinal virtue is in its vigour; and when its properties are lost by decomposition, or decay, the lichen which once characterized it is supplanted by another, which being interpreted, is the brand of proscription, and these are as intelligible as the autograph on the 'tables of stone,' for the same author is manifest.

Some lichens resemble Arabic, and others are like Hebrew characters; some display concentric circles, and others exhibit nebulous images, tinged with all the colours of the prism. The ruins of Kenilworth castle are singularly decorated with these symbols of creation, and many of them present an appearance like suns and moons in eclipse. The *lichen geometrica* adorns the rock

with all the involutions of isthmus, and of isle. The clay slate of Skiddaw yields fine specimens called ‘ map stone,’ and the rocks round the lake of Lucerne are rendered thus prettily picturesque. The *lichen lactea* communicates a singular appearance to the rock—that of being white-washed.

‘ Fallen stars,’ ‘ dead will o’ wisps,’ ‘ flowers of heaven,’ and the like, are, in all probability, associated with the phenomena of aërial vegetation, and connected with meteoric precipitations. The ‘ gory dew,’ *palmella cruenta*, and ‘ bloody rain,’ *lepraria kermesina*, which have so often terrified and alarmed, are referrible to these humble and harmless tribes of vegetation. In dry weather the ‘ gory dew ’ contracts and withers up, sometimes almost disappears, certainly sufficiently so to escape notice; when a shower comes on, it unfurls its ensanguined mantle on the plain, and superstition shudders as she passes the ominous spot, which appears as if blood had been spilt on the ground, and cried aloud for vengeance. Such scenes are described with these requisite adjuncts in legendary lore; but with what different sentiments and feelings does the intelligent mind contemplate these interesting phenomena! That which tinges the pool with *blood*, is a kind of moss; and I have met with it frequently in the interesting district of

Craven, in Yorkshire. The apparent drops of blood and violet spots which sometimes make their appearance in the bread-loaf, the mouldiness of cheese, fruit, &c., are phenomena that pertain to vegetation. The fruit mould, when examined by the microscope, is a pretty little plant. Parasites and epiphytes supply curious examples in eccentric vegetation; perched like birds' nests among the branches of trees, like the eagle, they love a lofty 'eyrie.'

The physiognomy of vegetation possesses varied and characteristic features. The fir tree and its sombre associates, with the beech and its silvery bark, adumbrate the cold regions of the North; while various pines tower loftily on the mountains of Nepaul, or grace the Orinoco and Ohio. The beech, oak, and ash, decorate these 'islands of the sea.' Spitzbergen has a tree, and it is a little one —the *salix herbacea.* The myrtle, orange, pomegranate; the fig tree, the almond, and the olive, may well become the 'garden of the world.' The Palmyra palm, cocoa nut, and other palms, with the banyan, bananna, and bamboo, are the ornaments of the East; and the bread fruit, and paper mulberry are characteristic of the Isles of Polynesia. The palm, magnolia, and almondrone mingle in the scenery of the Rio de Magdelena. The

pinus cembra, and the yew, are the indigenous graces of the alps, and fit furniture of the rock. The date palm, mimosa, and tamarix, are the garniture of the *oases*, or 'isles of the desert.' The olive looks no where so lovely as on the peaceful acclivity of Olivet, and the cedar of Lebanon loses half its charms and interest when disunited from the mountains of Lebanon, its birthright, and the natal soil of a long and illustrious line of patriarchal ancestry. The palm on the Aventine Hill at Rome, seems as much out of place as it would be on Salisbury plain.

The baobab comports well with the clime of the boa constrictor, and the curious, and leafless cassurina, with the banksia and epacris; the dryandra and solandria, and their rigid-leaved associates, are quite in keeping with the habitat of the ornithorynchus, kangaroo, and wombat. Palms, plantains, bamboos, and tree ferns, mingled with magnolias, barringtonias, bertholetias, and aristolochias, intertwined with trumpet flowers, and passion flowers, and arrayed with myriads of epiphytes—like Aaron's robes 'for glory, and for beauty,' with the almondrone piercing the thicket of a Brazilian forest, and even overshadowing with its branches the loftiest palms—these are surely appropriate adjuncts to the land of gems, and of

gold, and what so well becomes the Po as its pyramidal and stately poplar?

The palm, and the tree fern, the magnolia, and the almondrone, the cedar of Lebanon, and the oriental plane; the oak, pine, and Lombardy poplar, have each a grace and character peculiarly its own. The yew, cypress, and pistachio terebinthinæ, are mournful and funereal, and are apposite symbols for the monument and mausoleum, and form characteristic avenues for the Necropolis. The weeping birch, or 'lady of the woods,' is chaste in its drapery, and elegant in its attire, and so is the weeping willow, like "Niobe, all tears," interesting any where, but possessed of redoubled charms when drooping into the Euphrates, by 'Babel's stream,' near the ruins of Babylon. The oriental tamarix, in solitary grandeur, waves over these mounds, once palaces of the great, and the blast which sweeps over the desert, and sighs among its nodding plumes, seems to sympathize with fallen greatness—to mourn the loss of the "lady of kingdoms," and the ruin of the "golden city,"—once the "Chaldees' excellency," while the bittern, symbol of desolation, standing by the pools, mingles with the dirge.

The geography of plants is full of curious and singular interest, and owes almost every thing to

the genius of Humboldt. Some plants are true cosmopolites, and are found almost every where, enjoying with equal composure, opposite extremes of temperature. Some, on the other hand, are fixed at anchorage on particular spots, and never change, neither do their unplumed and unwinged seeds wander abroad. The bird and the breeze which transport so many, spare them. As examples of this attachment to birthplace and ancestral domain, the cedars of Lebanon have been named, confined to Libanus and the Taurian chain. The proteas, or the silver trees at the table mountain, Cape of Good Hope. The celebrated Maltese mushroom, *fungus melitensis*, like a vegetable prometheus chained to a rock; so zealously guarded in former times by the knights of Malta, and once considered a present sufficient for princes. The curious manita, or 'hand tree,' near the city of Mexico, is another of these curiosities. The doum, or many-headed palm, or urna palm, is chiefly confined to the region of the Thebaid. The Lombardy poplar claims the plains of Lombardy. The arbutus unedo seems 'at home' among the lakes of Killarney, and contributes much to the beauty of their scenery. The Cape is adorned with a profusion of the loveliest heaths. Our 'bosom friend,' the daisy, is a stranger to

India. The rose is a denizen of the old world, and is nowhere to be found in the southern regions of the new world. St. Helena possesses a vegetation altogether different from that on the nearest coast. The tree fern, the plantain, palm, and the bamboo, are intertropical. The Spice Islands stand renowned from their cloves, nutmegs, and cinnamon, and "all the powders of the merchant." The Island of Socotra is distinguished for the peculiar aloe that bears its name; and the 'coco de mer,' or double cocoa nut, *ludovico seychellarum*, is exclusively confined to the three Seychelles Islands of Madagascar. Thus do we meet, at the equator, with pepper, and the other natives of the Spice Islands, with cinnamon in Ceylon. Sandal wood, teak, ebony, and the banyan, luxuriate in the East. In Arabia Felix, we find balm, frankincense, and myrrh, coffee, and the tamarind. To the west of the Caspian, we meet with the apricot, peach, citron, and walnut. In Spain, Sicily, and Italy, the dwarf palm, cypress, chesnut, cork, oak, orange, lemon, and the pomegranate. In Britain, our native oaks and elms. In the North of Russia, the larch and fir. In the Orknies, the hazel, as well as on the shores of the Baltic. In the North of Stockholm, the hoary alder is seen, and the mountain ash, and sycamore in the Gulph of

Bothnia. When we pass the Dalphian chain, we meet in successional series, with the limits of the spruce fir, Scots' fir, dwarf birch,* and dwarf willow.† Within the arctic circle, the mezereon seems to linger, as well as white and yellow water lilies, and the European globe flower; and here we find the reindeer, and Iceland moss. Corn, wine, and oil, have their geographical range limited by what are called *isothermal* lines, or lines of equal temperature; moreover, these denunciations of latitude find their counterparts and analogues in altitude. We leave the banyan and baobab, the palm, and the plantain, in the plain below, then thread the zones of the fig, pomegranate, orange, olive, almond, and vine; then the region of the laurel, and their kindred trees; and afterwards at a greater elevation, the zone of the pine, and others in succession. We may find afterwards, at successive heights, the rhododendron, and gentianella, saxifrage, and soldonella, while the alpine traveller is finally introduced by some such plants as the *anthemis montana*, or the *saponaria depressa* to the region of eternal snows.

There is, moreover, a geological relation in the distribution of plants. The chesnut is eminently

* Betula nana. † Salix herbacea.

characteristic of a volcanic soil; and the castagna delle cento cavalli, on the flanks of Etna, is a memorable example. On the sides of Monte nuovo, where the myrtle grows, I also found the juniperus communis, and the erica cinerea. Myrtles and heaths are met with in the extinct crater of Monte Barbaro—the 'Gauris inanis' of classic lore; and there I discovered the lotus jacobeus. I noticed the arbutus unedo, myrtle, and others, among the debris of the smoking solfotara. The tanesetum vulgare is plentiful at the foot of the cone of Vesuvius. The mangrove delights in alluvial soil, the mud of the Lagoons, or to wade into the sea. The gentiana acaulis, and nivalis, rhododendron ferrugineum, and soldonella alpina, soar to the regions of the clouds, or ascend above them, and bloom best on the verge of the snow line. These, therefore prefer aiguilles of granite, or the debris of rocks, of a silicious kind. The eringo and glaucium flavum take their stations on the sea shore, and are sometimes washed by the wave. The crithmum maritimum, or rock samphire, though influenced by the sea-spray is always found beyond the reach of its billows. The statice, with its wiry-stemmed flowers, clings to the face of the rock at considerable elevations. The cocoa-nut and pinus maritima love the shore,

and the sea breeze. The salicornia, or glasswort, triglochin maritimum, and salsola kali, characterize the spot where brine springs are found, however remote from the ocean. These all, therefore, are associates of the saliferous system of rocks.

The wallflower, snapdragon, and pellitory of the wall spring from the fissures of ruins, where calcareous matter obtains, while the coltsfoot and foxglove are found in gravel pits—the diluvium of geologists.

The pinus larix is found, as well as the pinus cembra, on granitic mountains, among the alps; not on the Jura limestone. The barbacena and vellosia, in South America, appear to thrive only on quartzy mica slate. The salix herbacea appears to have a predeliction for gritstone rock. The primula, saxifraga, &c. climb to the highest elevations among the ruins of rocks; and, in like manner, the cloudberry soars to the summits of lofty mountains where clouds repose.

The erica, vaccinium, andromeda, cistus, ledum, and kalmia, are found in bogs and peat, and there, too, the dionœa, and the drosera spread their gins, and their snares, to catch flies. These may be said, therefore, to be the furniture of the carboniferous system. In like manner, the slate, the sandstone, and limestone formations, and their

subordinates of oolitic and cretaceous groups, will, in their aboriginal state, be found to be decorated with peculiar liveries of vegetation, as are the diluvial and alluvial wreck which springs from them; thus cacti, mysembranthemums, and stapelias, inhabit moving sands, and are the vegetable camels of the desert; and the Cape, or African bulbs, are plunged among burning sands, like alembics and crucibles in a sand bath. Orchises spring up among the the detritus of limestone and chalk, as well as the *reseda luteola* and *scabiosa*.

In point of size, trees exhibit the most remarkable extremes. The Chinese are famed in their way for producing minature trees artificially, especially the Japanese. M. Meylan saw in Japan, within the limits of a box, three inches long by one inch wide, a flourishing fir tree, a bamboo, and a palm, the latter in blossom; but apart from this consideration, a plant of the *rubus arcticus*, including roots, stem, foliage, and fruit, might be well enough contained in an eight-ounce phial, and, indeed, I have eight of these little *trees* growing in one flower pot. Mr. Cooper, member for Sligo, informs me that the Laplanders make a fine preserve of the fruit, and he has been often indebted to this source while travelling in that country, and

found it delicious and refreshing. The *salix herbacea,* the only tree of Spitzbergen and Greenland,* is so minute that several of these *trees,* roots, and all, might be enclosed in a letter, and transmitted by post. These are certainly minatures of their kind, and what might seem to belong to the land of Lilliput, but they have, nevertheless, as rightful a claim to the name of TREES as the baobab of the plains of Africa, or the great fan palm of Ceylon.

Immense is the size of the trunks of many oaks and elms in this country, and in former times they seem to have been equally gigantic. An oak was dug out of Hatfield Moss 120 feet long, and 36 feet in its greatest circumference. The mahogany tree, (swietenia mahogani) of tropical America, sometimes attains an enormous size. Messrs. Broadwoods, of London, purchased three logs cut from one trunk of mahogany for the sum of 3000 guineas. The baobab, or *adansonia digitata,* has been found 100 feet in circumference—a colossal size. The almondrone, I am informed, sometimes exceeds forty feet in circuit.

* Rev. Mr. Scoresby gave me a specimen of a minature salix from Greenland, which I am disposed to consider specifically distinct.

DRAGON'S-BLOOD TREE.

The gum dragon tree, *dracena draco,* in the Island of Teneriffe (see the above figure) is seventy-two feet high, and forty-eight feet in circumference; and according to Labillardiere, the largest cedar on Mount Lebanon measures twenty-eight feet round its trunk. Pliny mentions a plane in Lycia, with a cave in its trunk eighty feet in circumference, surrounded in the interior with seats of pumice-stone covered with moss. Lucinius Mutianus, the governor, and eighteen others, could conveniently dine there. Sir Stamford Raffles, when speaking of the Malayan forests,

says, that there are "creepers and vines twisted round other trees, and hanging, suspended for more than 100 feet, not less in thickness than the human body, and many much thicker. Trees 100 to 200 feet high—one measured nine yards in circumference;" and he adds, "this is nothing to one I measured in Java."

The 'castagna delle cento cavalli,' or the *chesnut of a hundred horse*, on the flanks of Etna, measures ONE HUNDRED AND EIGHTY FEET IN CIRCUMFERENCE, and though now apparently disunited, there can be no doubt whatever that the ruins once formed a single trunk. Dr. Sçhouw, of Copenhagen, informed me that he had the ground excavated for the purpose of ascertaining the question, and received convincing evidence of the fact. A ground plan of this celebrated chesnut is represented in plate II, fig. 12; the space represented by a dotted oblong square, is the *chalet* within the trunk, where they dry the chesnuts and almonds.

The sacred banyan of the Nerbuddah, with its 'alcoves and pillar'd shades,' is rather a *family tree*, but all are attached to the parent trunk, a numerous progeny. Its circumference is upwards of *two thousand feet* round the extreme limits of their branches: I have, in a preceding chapter,

supplied examples of trunks of Brobdinag magnitude.

In respect to the *age* of plants, some soon run the brief circle of their existence; they start into being, they bud, they flourish, and they fade in a few short hours—minutes sum up the measure of their being. The baobab of Senegal, the Oriental tamarix among the ruins of Babylon, the taxodium of Chapultepec, the chesnut tree of Etna, the cedars of Lebanon, and the olives of Gethsemane, may doubtless claim a vast and venerable antiquity.

A yew in Queen's County, Ireland, is computed to be 545 years old. It is eighteen inches in diameter, and has increased but little in size during the last three centuries: 100 rings may be counted in an inch. Another yew in Ireland has been considered coeval with the dawn of christianity. In Blenheim park there still exist the ruins of a tree which legend says once shaded the retreat of Fair Rosamond. Adanson mentions an immense tree in the Cape de Verd Islands, in which he discovered an inscription under 300 layers of wood; and a stroke of lightning revealed in the oaks of Sherwood forest, initials under numerous layers of wood coeval with the reigns of John, and William, and Mary. A tree was cut down in Kirkleatham park, round the inner bole, or heart,

(about a foot in diameter) besides some letters, perhaps initials, there was discovered in a *spiral form*, the following couplet:—

> 'This tree long time witness bear
> Two true lovers did walk here.'

Humboldt has thus chronicled the age of trees. The baobab of Senegal, the taxodium, or deciduous cypress of Chapultepec, and the dragon-tree of Orotava.

In *exogenous* trees, the age, or period of their existence, is computed from the number of concentric rings in the wood, each ligneous cylinder being a year. In *endogenous* trees, such as the palms, nothing of this kind is observable, and their growth obeys a different law. Some Brazilian cocoa-nut palms have been computed to be nearly 700 years old. A huge baobab in Senegal, Adanson computed to be no less than 5,150 years old!—a good old age truly. This calculation seems, however, to be altogether extravagant, though it may still be, as Humboldt has observed, "the oldest organic monument on the surface of the globe." We are inclined, for various reasons, to deduct a large amount from the days of the years of its more than antediluvian life. This

'Methuselah' of vegetation, possesses, I believe, invariably, a *twin* trunk, and such is the case in that figured in Lord Macartney's 'Embassy to China.' This circumstance would materially affect the calculations; the early coalescence of two stems into one, would indeed altogether nullify the data; and may not many trees, and the baobab among the number, deposit more than *one* cylinder of wood within the circle of the year? We must not limit the growth of trees in intertropical lands, and regions of perpetual spring, to the periods of growth which belong to our seasons in these latitudes. I have a section of ivy where there are two centres of growth, and I also possess a specimen of green ebony, with a distinct and independent centre of growth in the *duramen*. In some limes which I have seen at Powis Castle, the amalgamation and coalescence were so complete as to baffle all attempts of this kind. Some kinds of *ficus*, near Mexico, coalesce, and are hence called 'brothers.'

Where the tree has been most exposed, and subject to the blast, while the centre of growth stands firm, the rings will be found considerably compressed, and some of them almost merged; the centre will therefore appear as if it had been pushed nearest the side which had sustained the

shock. Thus the phenomena of these rings are curious archives, in which we may read, to a certain extent, the years of its sojourn; they become also the roll and register of its combat with the blast, and its adventures with the season; for that part of the trunk in which its ligneous matter is developed, it is reasonable to think, must have been most sheltered, and secured from extrinsic agencies of a counteracting kind, as well as most influenced by the genial effects of the sun. On the other hand, where the rings are compressed, and the trunk seems to have suffered a collapse, there the storm and brumal agency seem to have operated, and, as Mr. Babbage has lately suggested, it becomes, within proper limits, interesting in another way, namely, as a record of the character of the various years that have passed away in relation to the favourable, or unfavourable aspect of the seasons in the phenomena of growth; thus the narrow concentric rings may be considered unfavourable, and the broader rings, favourable years. In firs that skirt the line of perpetual snow, thirty, or more annual rings, may be counted in a tree not exceeding two inches in diameter; *magnitude*, therefore, affords no key to the secret of growth.

In the phenomena of exogenous vegetation, we

find many independent proofs that the results we obtain by computing the age of trees from the number of concentric rings must not be dogmatically asserted. The zones of wood in bauhinias are so unequal and irregular as to perplex the observer. In the tree birthwort there is only a solitary zone of wood, let the age of the tree be what it may. In the calycanthus, again, there are *four* centres of growth, each with its individual concentric circles, at equal distances in the bark, and on the external part of the mass of wood. Some trees evolve two sets of blossoms in the year, and it is not improbable but many may form more than one concentric cylinder of wood within that period.

The palm among the princes of vegetation, the fig tree, and the olive tree, still decorate the land of promise, though Jericho is no more, and the site of Palmyra is only known in the ruins of Tadmor. The cedars of Lebanon still vindicate their prescriptive right to the chains of the Taurus and Libanus, though Tyre, once the seat of 'merchant princes,' is reduced to a few huts of fishermen. Bashan is still celebrated for its oaks, as in the reign of the kings of Judah. The olive still flourishes on Olivet; and those of Gethsemane may be scions of their forefathers destroyed by the ruthless hand of Titus Vespasian, at the siege and

sack of Jerusalem. The ‘ lily of the field,’* still decorates the plains of Palestine with golden blossoms. The sycamore still skirts the shores of Gennesareth, and Sharon is still the land of roses. The willow still weeps by the Euphrates, as when the captives of Israel suspended their harps by its stream, and their dirge was like the song of Shilrac, “ soft, but sad. The *tamarix orientalis,* the solitary tree among the ruins of Babylon, is perhaps an offset of some of those trees which once decorated the pensile gardens of Nebuchadnezzar’s palace.

The ‘ paper reeds by the brooks,’ are still found there, as in prophetic times. The ‘golden bough’ of Eneas still lives in the land of classic Greece. The ‘ Shittah tree’ is found, as of old, in desert places, and the palm still points out some Elim and its wells. The *henna* still remains where it did when the mummy lived, and walked the streets of Thebes with its hundred gates,† some four thousand years ago. It is true the fields of Heshbon “ languish ;” but the wheat of that district is rich in the ear, almost beyond a parallel. ‘ Araby the blest ’ is still the natal

* *Amaryllis lutea* according to Sir J. E. Smith.

† ‘ Thebe portarum centum nobilis fama.’—*Pliny,* B. 5, c. 9.

clime of balm, frankincense, and myrrh, as when the Ishmaelites traded thither. There is still 'corn in Egypt,' once the 'granary of the world,' and it is still as famed for its "onions, cucumbers, and melons," as before the exode. The sacred lotus, too, still floats on the waters of the Ganges, as it did before the cave temples of Elephanta and Elora were hewn out of the living rock.

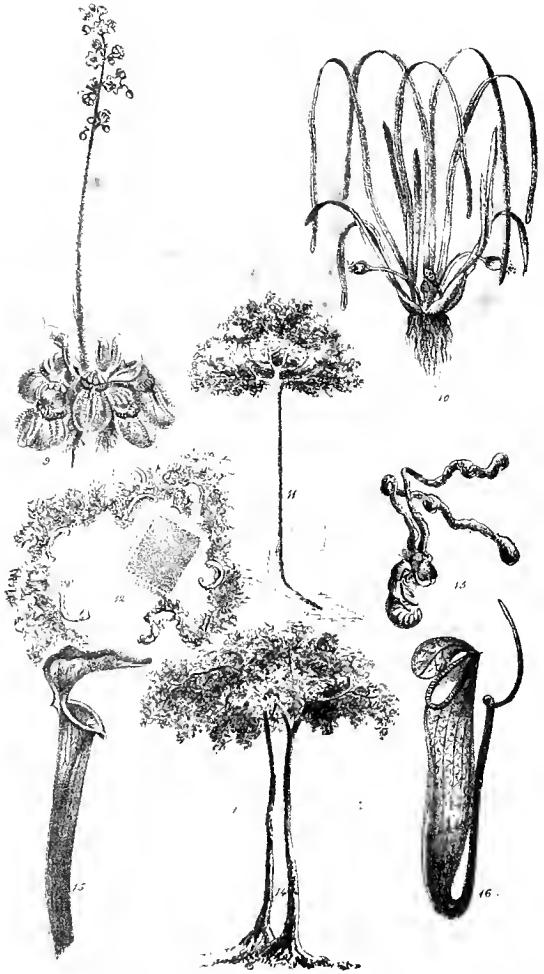
Can we doubt that a PROSPECTIVE PROVIDENCE arranged the curious apparatus and mechanism of plants, and invested them with the principles of self-adaptation to meet the events and contingencies of the future? Did they make the provision for themselves, in all the majesty of INFINITE PRESCIENCE, in the void of nothing? Were they an intelligent something, while as yet they were nothing? The truth must be confessed —these phenomena of vegetation insulated and disjointed from an INFINITELY WISE AND INTELLIGENT CREATOR, form an enigma which defies solution.

"When I would beget content and increase confidence in the power, wisdom, and providence, of ALMIGHTY GOD, I will walk the meadows by some gliding stream, and there contemplate the lilies that take no care, and those many other living creatures, that are not only created, but fed

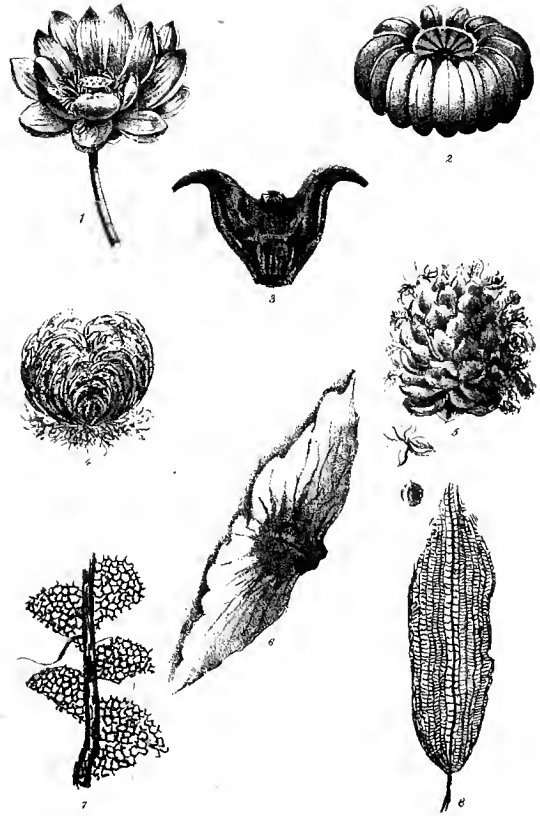
(man knows not how) by the goodness of the GOD of nature, and therefore trust in him."—*(Isaac Walton.)*

ERRATUM.—Page 14, note—for "Rosaria biflora pesti," read "Biferique rosaria pesti."

FLETCHER AND SON, PRINTERS, SOUTHAMPTON.



T. H. Skelton Lith., Southampton.



T. H. Skelton Lith. Southampton